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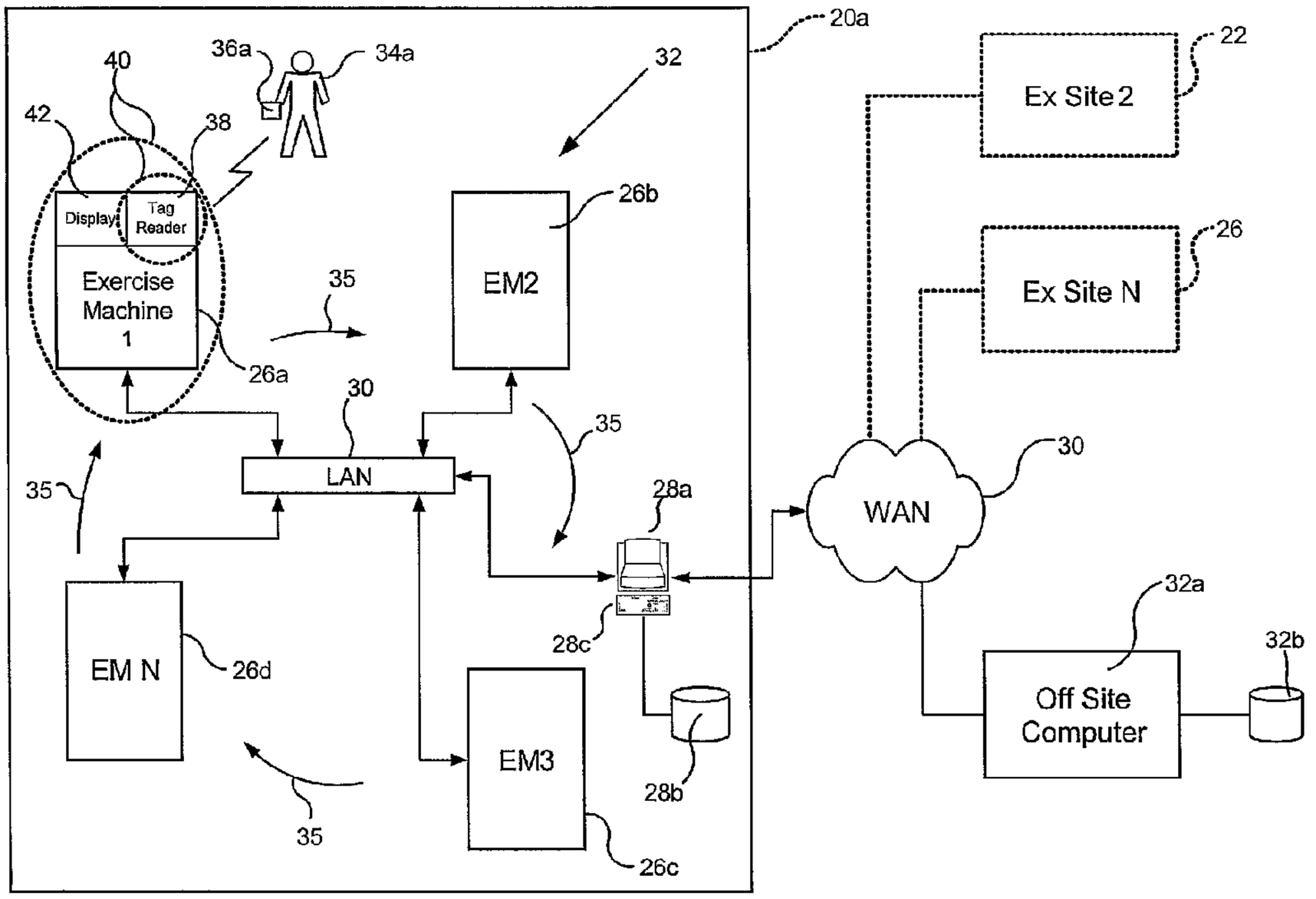
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(54) Titre : SYSTEME ET METHODE DE CIRCUIT D'EXERCICE
(54) Title: EXERCISE CIRCUIT SYSTEM AND METHOD



(57) Abrégé/Abstract:
A system and method for providing an automatic identification, or a combination of automatic identification and automatic or manual programmed training, for more than one user on at least one exercise machine. The exercise machine is equipped with a user identification device that is in data communication with a system having an identification system and a storage database. The method includes automatically identifying, monitoring and interfacing exercise machine information and database information for at least one user by detecting automatically the presence or absence of a user identification tag and using a default profile or a specific user profile load predetermined difficulty settings or user defined difficulty settings into the programmable exercise machine, which includes resistance or repetition settings.

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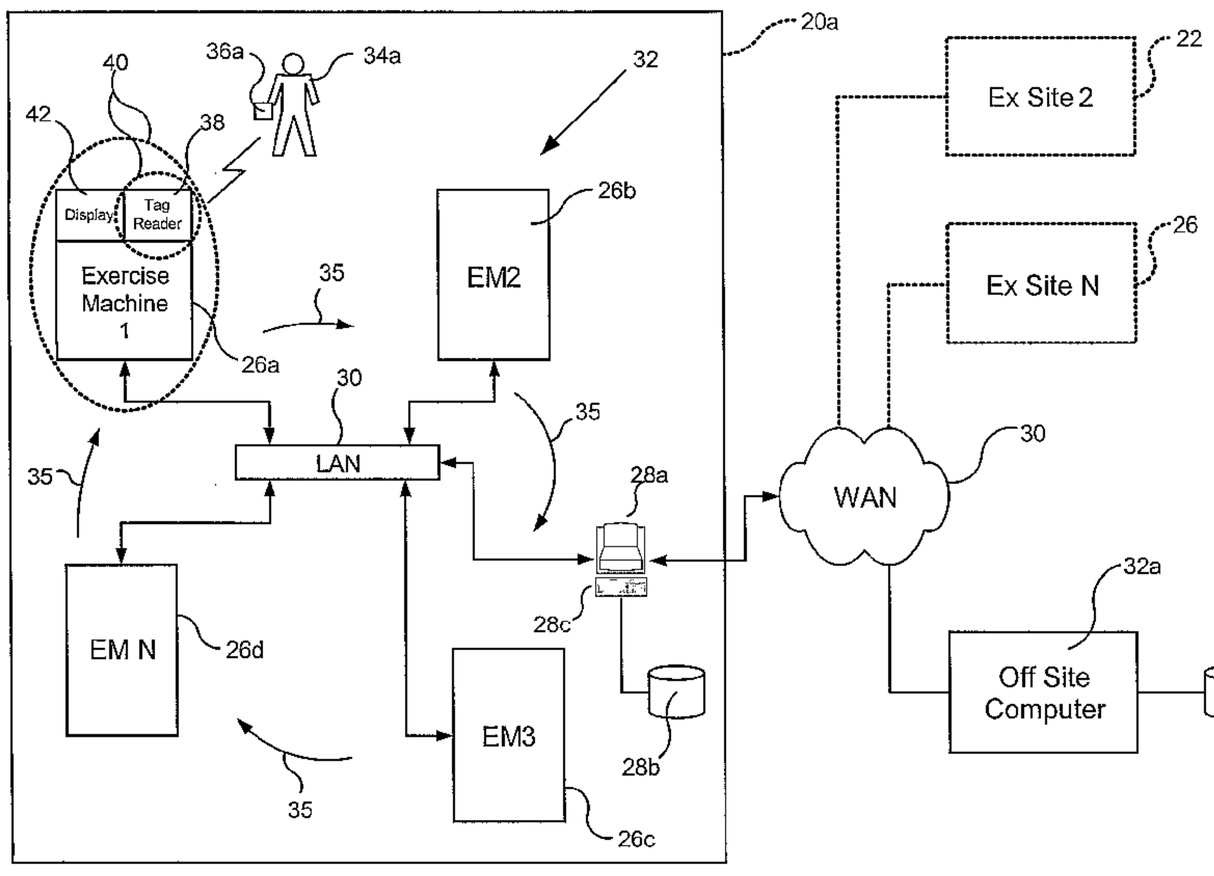
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EXERCISE CIRCUIT SYSTEM AND METHOD

RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Patent Application, Serial Number 60/632,667, entitled "Exercise Circuit System and Method," filed on December 02, 2004, having Gravagne et al., listed as the inventor, the entire content of which is hereby incorporated by reference.

STATEMENT OF RIGHTS TO INVENTIONS MADE UNDER FEDERALLY SPONSORED RESEARCH

[0002] No federal grants or funds were used in the development of the present invention.

BACKGROUND

[0003] The invention is generally related to exercise equipment using RFID tags, sensors, display units, and network computers to monitor and individualize exercises for a multitude of users. More specifically, this invention is related to a method monitoring and individualizing exercises for a multitude of users.

[0004] Circuit training is one form of exercise that allows for simultaneous aerobic and anaerobic exercise. A systemic aerobic workout can be achieved by doing a continuous series of anaerobic exercises. Generally, circuit training combines about 8-10 exercises that are completed one right after the other, with little or no rest in between. Circuit training is a fast efficient workout, and many people that utilize circuit training want to monitor their progress. Stopping the rapid pace of exercise for any reason is undesirable during circuit training. This includes stopping after every exercise routine to write down progress, notes, or measurements. In order to minimize interruption to the circuit training exercise routine, some machines have been developed that can monitor various parameters and track a user's current and past exercises. However, such machines need some type of user action to indicate who is using the machine. Thus, even when a machine is capable of tracking progress, it is generally impractical and undesirable for the user to take any explicit action to notify the exercise machine that a specific user is presently manipulating the machine. For example, if a track runner wanted to know and monitor his split times for each 100 meter segment in a 400 meter race, the overall race

performance would be hampered if the runner needed to manipulate his watch (or another monitoring device) at each 100 meter segment. Thus, it would be impractical for the runner to do anything that altered his performance during the race, even if the action only took a short time (e.g. about 1 or 2 seconds), which could cost the runner the race. Similarly, the user of circuit training equipment should NOT stop exercising for any reason during the circuit routine. Ideally, the user of circuit training equipment should be able to walk up to an exercise machine and start using it with a zero time delay.

EXERCISE EQUIPMENT..

[0005] United States Patent 6,702,719, ("the '719 Patent") issued to Michael Brown et. al., titled "Exercise Machine," describes an exercise machine which is capable of monitoring various parameters while the user exercises. These measurements may then be stored on some (possibly detachable) storage device, or transmitted across a network to a remote storage device. However, the machines described in the '719 Patent are alerted to the identity of a particular user only if the user attaches a small computer system (termed a "personal exercise monitor device") which can identify that user, or if the user enters their personal identification data manually via a keyboard or other data entry device. This is impractical for circuit training because each user may spend a maximum of, for example, 30 seconds at each machine. Users cannot realistically be expected to enter keystrokes to identify themselves to the machine, or to attach (and subsequently detach and carry with them) any type of identifying monitor device.

[0006] United States Patent 6,659,946, ("the '946 Patent") issued to Stephen Batchelor et. al., titled "Training System," describes a system whereby exercise machines may adjust to a user's personalized exercise needs, and also monitor the user's exercise measurements. Each machine described in the '946 Patent is outfitted with a smart-card reader and a small computer system that, after reading the contents of a user's particular card, adjusts the machine accordingly. Sensors on the machine are monitored by the computer system, which then stores measurements from those sensors on the card before the user disembarks from the machine. There are two major drawbacks to this architecture for circuit training scenarios. The first is that, like the '719 Patent, the user is not automatically identified once they engang machine, but must place or swipe their card in the reader before beginning the exercise. The second is that the user may not disengage

from the machine at any time, but must either wait until the computer system indicates that the exercise is over, or manually indicate to the computer system that he/she wishes to end the exercise. Otherwise, that user's exercise measurements will not be stored on the card for later retrieval.

[0007] United States Patent 5,931,763, ("the '763 Patent") issued to Nerio Alessandri, titled "System for Programming Training on Exercise Apparatus or Machines and Related Method," describes a system similar to the '946 Patent. In it, each exercise machine adjusts to, and stores the exercise measurements of, a particular user that it identifies by a "portable medium" described as an "electronic key." As before, this key must be intentionally inserted into a particular receptacle on the machine by the user – the identification is not automatic. Once the user (or the machine) has terminated the exercise, the key may not be withdrawn until the machine's computer controller has written the pertinent exercise measurements and statistics into the key's memory. At some point in time, the user must then bring the key to a computer terminal so that all of its data may be downloaded and permanently stored.

[0008] United States Patent Application 10/819,052 filed by Brent Anderson et al., titled "Health Club Exercise Records System," and published as 2004/0198555 A1, turns the identification problem around. Users carry small handheld portable computers, each equipped with a tag reader. Machines are uniquely tagged, so that when the handheld device comes within range of a given machine's tag, information about that machine is automatically known. Thus, the handheld unit may display motivational information to the user which is customized to that machine. However, no mechanism is given by which the machine may either adjust itself to a given user's profile, nor record and store that user's exercise measurements for later use.

[0009] United States Patent Application 09/776,410 filed by Watterson, et al., on February 2, 2001, and titled "Methods and Systems for Controlling an Exercise Apparatus Using a Portable Remote Device," ("the '410 Application"), and published as 2002/0022551. The '410 Application describes a portable system retrieves one or more exercise programs from a remote communication system that provides motivational content for a user exercising upon an exercise mechanism. The exercise program further includes at least one control signal that controls one or more operating parameters of the

exercise mechanism. The portable system includes a control device configured to retrieve the exercise program and deliver the motivational content to the user by way of an audio delivery device, while delivering the control signals to the exercise mechanism. A sensor communicates with the control device and tracks one or more measurable parameters of the user during the user's performance of the exercise program. Data representative of the one or more measurable parameters can be delivered to the control device for delivery to the remote communication system.

[0010] However, each of the machines listed above have problems, especially in connection with circuit training. What is needed is the ability for a user to walk up to an exercise machine and have the machine automatically recognize the user, retrieve the user's profile and modify the user's profile while the user is exercising. One method of wireless communication between the user and the machine is an RFID tag and RFID antenna in combination with a communication network by which a particular user's exercise measurements and statistics may be transmitted to a storage database, and by which a particular user's exercise settings may be retrieved from the database. For example, the '410 Application furthermore assumes that one given user is solely using the machine, and it is not capable of distinguishing between multiple users and tailoring the exercise for each one differently.

[0011] **Radio Frequency Identification**. Radio Frequency Identification (RFID) is a technology that is used to locate, identify and track many different types of items, such as clothing, laundry, luggage, furniture, computers, parcels, vehicles, warehouse inventory, components on assembly lines, and documents. RFID transponders, and RFID tags, are used in much the same way as optical bar codes, identifying the item to which they are affixed as being a particular individual or as being part of specific group. Unlike bar codes, RFID transponders can be read even when they cannot be seen, and hence a "direct line of sight" for transmitted RF energy and reflected RF energy is not required between interrogation device and the transponder. Furthermore, the identification numbers of a multiplicity of transponders can be read virtually simultaneously, with little or no effort on the part of the user to "aim" the interrogation device at each and every transponder. Some RFID transponders can store information in addition to that used for identification. This additional information may also be re-programmable by the user.

Information within the transponder is typically accessed by a process variously referred to in the art as "scanning," "reading," or "interrogating."

[0012] RFID transponders are typically interrogated by a radio transceiver with some added intelligence to enable it to send and receive data in accordance with a communication protocol designed into the transponder. When interrogating one or more transponders, the transceiver transmits RF energy to the transponder, and encodes information on the outgoing signal by modulating the amplitude, phase and/or frequency of the signal. The RFID transponder can receive this signal and interpret the information sent by the interrogating device, and may also then respond by sending information contained in reflected RF energy back to the interrogating device.

[0013] RFID transponders are often classified as either active or passive. An active transponder is continuously powered by a battery or alternate power source. In contrast, a passive transponder obtains its power from the RF field imposed upon it by an RFID transponder interrogation device. A passive RFID transponder, therefore, must remain close enough physically to the interrogating device to obtain adequate power to operate its circuits. Typically, the range for a passive transponder will be less than that of an active transponder, given that the interrogating device is transmitting the same amount of RF power at the same frequency for both types of transponders.

[0014] RFID transponders may be constructed from discrete components on a circuit board or they may be fabricated on a single silicon die, using integrated circuit ("IC") techniques and needing only the addition of an antenna to function. Transponders are generally designed to operate in one of a number of different frequency bands. Popular frequencies are centered around 125 kHz, 13.56 MHz, 915 MHz and 2.45 GHz. These particular frequencies are chosen primarily because regulations in many countries permit unlicensed operation in these bands, and the permitted transmission power levels are suitable for communicating with and/or providing power to the RFID transponders. Transponders operating at lower frequencies (e.g. 125 kHz and 13.56 MHz) generally require larger antennas, and typically employ inductive coupling via multiple-turn coils to achieve a small antenna size. High frequency transponders typically utilize electric field coupling via simple half-wavelength dipole antennas. For example, 2.45 GHz transponders can use simple paper-thin, printed-conductor antennas as small as 60 mm by 5 mm. In

contrast, 125 kHz transponders typically use a coil antenna, usually either made of many loops of wire or of a foil spiral affixed to a substrate material. In low frequency transponders, both coils and printed spirals must be quite large in order to achieve an appreciable operating range. Examples of such transponders may be found in U.S. Pat. Nos. 4,654,658 and 4,730,188.

[0015] RFID transponders are typically identified by a number contained within a memory structure within each transponder. This memory structure may be programmed in a variety of ways, depending on the technology used to implement the memory structure. Some transponders may employ factory-programmable metal links to encode the ID. Others may employ one-time-programmable ("OTP") methods, which allow the end user to program the ID. This is often referred to as Write Once, Read Many (WORM) technology, or as Programmable Read Only Memory ("PROM"). Both fusible links and anti-fuse technologies are used to implement this method of storage. Still other technologies allow the user to program and re-program the ID many times. Electrically Erasable Programmable Read Only Memory ("EEPROM") and FLASH memory are examples of technologies that can be used to implement this type of access. The transponder ID number is typically stored in a binary format for ease of implementation, though other representations could be used.

[0016] When multiple RFID transponders are within range of the interrogating device, it is typically desired to be able to identify all of the transponders in the field. Once the transponders have been identified, their presence may be noted in a computer database. Following identification, each of the transponders may also be addressed individually to perform additional functions, such as the storing or retrieving of auxiliary data.

[0017] The ability of the system to efficiently identify the presence of a multiplicity of transponders is highly dependent upon the communications protocol used to interrogate the transponders. Among those familiar with the art, a protocol suitable for allowing multiple transponders to respond to an interrogation request is typically referred to as an "anti-collision protocol." The process of singling out one transponder for communication is typically referred to as the process of "isolation."

[0018] Most anti-collision protocols communicate between an interrogation device and *RFID* transponders present in an RF field have relied upon pseudo-random

number (PN) generators. PN generators are typically used to vary the time during which the transponders may respond, so as to eventually allow a response from each transponder to reach the interrogation device without colliding destructively with the response from another transponder. Examples of such protocols can be found in U.S. Pat. Nos. 5,537,105, 5,550,547, and 5,986,570.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The following drawings form part of the present specification and are included to further demonstrate certain aspects of the present invention. The invention may be better understood by reference to one or more of these drawings in combination with the detailed description of specific embodiments presented herein.

[0020] Figure 1 shows a diagram of the enterprise view of the circuit exercise system;

[0021] Figure 2A, shows a diagram of one site within the enterprise circuit exercise system; Figure 2B shows an alternate diagram of one site within the enterprise circuit exercise system without a local computer and local database;

[0022] Figure 3A shows an RFID tag ring; Figure 3B shows an RFID tag reader; and Figure 3C shows a partial perspective view of the control panel of an exercise machine having graphic (e.g. LCD screens), non-graphic (e.g. LED lights); and acoustic (e.g. tones, or speaker) feed back devices and an RFID tag reader;

[0023] Figure 4A shows a flow diagram of a method for user identification and usage tracking of an exercise machine without cache; Figure 4B shows a flow diagram having the user identification and usage tracking of an exercise machine with cache; Figure 4C shows the decision tree 58 for "does the profile exist in the database?";

[0024] Figure 5 shows a flow diagram showing the decision tree for a system of determining "Has the User Changed?";

[0025] Figure 6 shows a flow diagram showing the system of updating a user's settings for a particular machine once that user has completed an exercise on that machine;

[0026] Figure 7 shows a flow diagram showing the system of retrieving a user's settings for a particular machine once that machine has identified the user;

[0027] Figure 8 shows a typical layout of circuit training machines;

[0028] Figure 9 shows a system layout of a single leg extension exercise machine having a hydraulic cylinder and a linear displacement sensor.

SUMMARY

[0029] A system for providing: (a) an automatic identification, or (b) a combination of automatic identification and programmed training (either automatic or manual), for a particular user out of a multiple of users on at least one exercise machine which is equipped with a user identification device, the system comprises an identification system and a storage database, wherein the identification system is in communication with the storage database whereby settings of that particular user can be transmitted to, and retrieved from, the storage database. The identification system can be a radio frequency identification ("RFID") system, which has an RFID tag and an RFID antenna. The system can have a communication network facilitating the communication between the RFID system and the storage database. The profiles of a particular user are information stored on the database and transmitted to the exercise machine, which can be used to change in any settings on the exercise machine. The exercise machine can have at least one sensor from which measurements from a particular user can be collected and transmitted to the storage database. The system can be used in a circuit training.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0030] *Terms:* It will be readily apparent to one skilled in the art that various substitutions and modifications may be made in the invention disclosed herein without departing from the scope and spirit of the invention.

[0031] The term "a" or "an" as used herein in the specification may mean one or more. As used herein in the claim(s), when used in conjunction with the word "comprising", the words "a" or "an" may mean one or more than one. As used herein "another" may mean at least a second or more.

[0032] While one embodiment of the present invention is discussed in detail below, it should be appreciated that the present invention provides many applicable inventive concepts that can be embodied in a wide variety of specific contexts.

[0033] As discussed above, the invention is generally related to exercise systems and equipment using RFID tags, sensors, display units, and network computers to monitor and individualize exercises for a multitude of users. More specifically, this invention is related to a method for monitoring and individualizing exercises for a multitude of users simultaneously. A systematic circuit training workout utilizes a continuous series of exercises, and these exercises can be completed in groups having up to or about 8-25 or more people that are training on up to or about 8-25 machines or mor for a fixed period of time and the exercises are completed one right after the other, with little or no rest in between. A typical layout of circuit training machines is shown in Figure 8. Due to the fast paced nature of circuit training, an efficient workout is hampered by any stoppage of the rapid pace of exercise for any reason, including waiting on a machine to recognize the specific user of the machine.

[0034] Generally, in order to monitor and adjust the progress of a defined circuit training user, certain parameters should be identified and relayed to an interactive system without having the user of the circuit training equipment perform any task other than the specific circuit training exercises. Because circuit training is generally performed in groups, any interactive system that is to be implemented should also have the ability to perform the required monitoring and adjusting functions with more than one user on more than one machine simultaneously. In a preferred embodiment, the interactive system

should have the ability, theoretically, to monitor and update a single user's profile even if the user is exercising on two separate machines simultaneously. As used herein, "profile" means the entire collection of settings, user ID number, user's name, date the user last used the machine, and any other relevant information for a particular given user. "Settings" include information stored on the database, and transmitted to the exercise machine, that can change in any way the state of the machine. Thus, settings also include user information that gets displayed or what position the valve motors must take to adjust the resistance of the machine.

[0035] As a specific example, an interactive circuit training system having two machines (e.g. a leg extension machine and a chest press machine) and two human users (e.g. User 1 and User 2) should be capable of identifying which user is using what machine. The interactive circuit training system should be also capable of setting or recording any machine parameters based upon the specific user's profile. Additionally, the interactive circuit training system should be capable of monitoring and updating the specific user's profile based upon the user's use of any specific machine. Thus, if User 1 is using the leg extension machine, and User 2 is using the chest press machine, the two users and their exercise patterns for each specific machine should be identified and recorded as the exercises are being conducted. When the User 1 and User 2 switch machines, this change should also be noted in the interactive system along with the progress for each user on each of the specific machines. However, one of ordinary skill in the art will recognize that for a period of time when User 1 and User 2 are switching machines, one or both machines are inactive. The inactivity of one or both machines introduces the logistical problem of trying to determine whether or not User 1 or User 2 has completed a specific exercise, completed the circuit, is resting, or has moved on to the next exercise. During the inactivity of the machine it may not be clear whether the user profile should be updated, or whether a specific timeout should be initiated until the next user interacts with the machine. In order to solve this problem, the concept of a "phantom user," User 0 in our example above, has been introduced.

[0036] The term "phantom user," as defined herein, refers to a default user profile that is to be considered active on any circuit training exercise machine when a User ID tag is not detected by the exercise equipment. For example, when human User 1 or human User 2 are switching machines, the phantom User 0 is considered to be using any

or all machines at the moment that the machines do not identify a human user having User ID tag. Alternately, the phantom User 0 profile may be used for a human user that does not have a User ID tag. This concept is also discussed in detail in the examples listed below.

[0037] Generally, an interactive system for identifying, monitoring, and updating exercise profiles of more than one different exercise machine users is described. The interactive system comprises a local area network first site computer comprising a database including a multitude of individual records for each first site user of the multitude of different exercise users, the records including at least an individual machine resistant setting and a user ID number.

[0038] A method of automatically monitoring and individualizing exercises for a multitude of users is disclosed. "Automatic," as used herein, means that no action from the user is needed, or must be taken, for the system to do what is recited outside the process of mounting, using, and dismounting the exercise machine. The method comprises the steps of providing a first-site particular user with a unique exercise-machine proximity activated identification tag. A first exercise site or location is provided for a multitude of first site exercise machine users, having a multitude of different exercise machines, some of which may be capable of accepting a multitude of user settings for at least one adjustable machine operating parameter (including, for example, at least a machine resistance) is provided. The exercise machines include a tag reader for repetitively and automatically monitoring a proximity area unique for each exercise machine and for automatic wireless communication with a user-worn proximity-activated identification tag entering the proximity area and automatically transmitting a digital signal corresponding to such identification tag. Some of the exercise machines may also be capable of transmitting signals relating to the user repetitions of the machine. A local area network ("LAN") is provided for automatic engagement and automatic communication with the exercise machines and includes at least a first site computer, having a database including a multitude of individual records for each of the multitude of site users. The individual records may include a machine user resistance setting for each different machine. The first site computer identifies individual particular users and may be capable of automatically providing a setting of the machine operating parameters of the machine in accordance with individual record of each user. The first site computer may,

after identification of the user, automatically set a first machine at an individualized setting for a first user, when a first user is in the proximity area of the first machine. The computer may set, again, automatically a second machine of the multitude of different machines at an individualized setting for a second user when the second user is in the proximity area of the second machine. This automatic identification and setting may continue an "Nth" machine of the multitude of different machines at an individualized setting for an Nth user when the Nth user is in the proximity area of the Nth machine. The first, second and Nth machine are operated by the first, second and Nth user respectively, typically simultaneously during a first time period.

[0039] The first site computer may store the repetitions (or other machine operating variable) of each machine in the records identified with each first, second and Nth user. Optionally, the first site computer may reset the first machine at an individualized setting for the Nth user, when the Nth user is in proximity area of the first machine; reset the second machine at an individualized setting for the first user when the first user is in proximity area of the second machine; and reset the Nth machine at an individualized setting for the second user, when the second user is in proximity area of the Nth machine. The first, second and Nth machines are operated by the Nth, first and second users, respectively, simultaneously, during a second time period, and the first site computer stores the repetitions (or other machine operating variable) of each machine in the records identified with each first, second and Nth user. Optionally, the programmed first site computer may change the individualized machine settings of the first, second and Nth uses in response to signals received from the machines during at least the first and second time periods. The system includes communicating individual user records (including identification) with a wide area network, the wide area network for sharing information related to a multitude of user records from the first site with a multitude of additional user records at additional sites.

[0040] An interactive system for exercise of a multitude of different exercise users is also disclosed. The interactive system comprises a local area network first site computer comprising a database including a multitude of individual records for each first site user of the multitude of different exercise users, the records including at least an individual machine resistant setting and a user ID number.

[0041] A multitude of user-carried proximity-activated personalized ID tags are provided for the site users. A first site typically includes a circuit having at least a first and a second exercise machine. Each machine typically includes a tag reader capable of repetitively sampling a unique machine proximity area for the presence of an ID tag. The reader is capable of communicating with the LAN first site computer, and some of the machines may be capable of adjustably accepting a machine operating parameter (one such machine operating parameter being machine resistance). At least some of the machines may be capable of sending a signal relating to a machine operating variable (one such machine operating variable being, for example, the number of repetitions the exercise user performs on a machine-actuated moving part). The LAN first site computer is capable of automatically identifying individual records and of automatically receiving an initial set of machine operating parameters including at least a machine resistance for the first and second machines. Optionally, the LAN first site computer is automatically, or manually, programmed to set the first and second machines at the initial resistance settings in response to a signal from the tag reader. In addition, the local area network computer is typically further capable of receiving the signal related to the machine operating variable and may also be further capable of automatically changing the initial settings to new settings and the new settings to subsequent settings in response to the machine operator variable signals.

[0042] A wide area network for communication with the local area network first site computer may be used for automatically receiving periodically and automatically updating individual records from the local area network first site computer and from a multiplicity of other local area network site computers. An offsite computer engages the WAN for communicating with the first and the multiplicity of other LAN computer to make available records to all site computers for identification of all site users and, optionally, for automatically setting machine operating variables of all site exercise machines and for optionally receiving and changing settings in response to machine operating variables from all such machines.

EXAMPLES

[0043] The following examples are provided to further illustrate this invention and the manner in which it may be carried out. It will be understood, however, that the

specific details given in the examples have been chosen for purposes of illustration only and not be construed as limiting the invention.

EXAMPLE 1

[0044] An interactive system for circuit training machines does not need to be limited to a single exercise facility. In a preferred embodiment, several circuit training exercise facilities (sites) can be linked using a wide area network ("WAN") connected to a database holding specific user profiles. As shown in Figure 1, the enterprise circuit exercise system (10) of the current invention has a plurality of exercise sites (20a-d) that are in data communication with each other and with an "off-site" computer site (24) via a wide-area network (22), also referred to as a WAN. It is to be understood that "Exercise Site N" (20d) indicates that there may be one or more exercise sites (20a-d) within the enterprise circuit exercise system (10).

[0045] Each exercise site may or may not be located in the same city, state, or region of the world. Each exercise site has at least one exercise machine connected to a local area network ("LAN") that is connected to the off-site database through the WAN. Alternatively, each exercise site may have its own database that may or may not be connected with the off-site database. Additionally, an exercise site having its own database may have data communication with a second site or an off-site database.

[0046] A general layout of Exercise Site 1 is shown in Figure 2A and Figure 2B. Generally, a user will have a User ID tag (36a), and the exercise machine (26a-d) will have a User ID tag reader (38) in data communication with a database (28b or 32b). The database holds at least some minimal information on the user, including the information that the user does not exist, or is using a default profile, or phantom profile. User profiles can be modified by a specific human user by interacting with a specific exercise machine at a specific exercise site. As shown in Figure 2A, a human user (34a) using Exercise Site 1 (20a), and typically all exercise sites (20a-d), are comprised essentially of a plurality of different exercise machines (26a-d), a site computer (28a), and a wired or wireless local area network (30), also referred to as a LAN, to effect communication between the exercise machines (26a-d) and the site computer (28a). The exercise machines (26a-d), site computer (28a), and network (30) together comprise some of the physical

embodiments of the present invention. The different exercise machines (26a-d) of the present invention comprise the circuit of the present invention and are well known in the art and may be comprised of elliptical machines, stationary bicycles, electronic weight resistance machines, treadmills, stair-step machines, or the like. The exercise machines (26a-d) are adapted to identify a multitude of users (34a-c) at all times during any given exercise period and, where appropriate and desired, the exercise machines can programmatically adjust the settings of the exercise machine and track usage statistics of during any exercise period. As such, each exercise machine always has an identified user profile and is monitoring the usage statistics, even when the machine is not in use, or a human user does not have an identification tag. Thus, when the exercise machine does not detect the User ID tag, the user is considered to be a "phantom" user, even when the machine is not in use. Additionally, the exercise machines (26a-d) are adapted to include a microcomputer (not shown) to facilitate the automatic communication, processing, data storage, and retrieval needs of the current invention.

[0047] Figure 2B shows a diagram of another embodiment of the present invention of one site within the enterprise circuit exercise system without the use of a site computer or a local database.

[0048] Typically, an exercise machine (26a-d) of the present invention is adaptable to have its settings, for example resistance, programmatically (automatically or manually) adjusted. The site computer (28a) may further comprise a local database (28b) and an attached keyboard (28c). The local database (28b) stores all of the settings for the plurality of exercise machines (26) for each user (34a-c) having a User ID tag, and for the phantom user. The local database (28b) also stores usage statistics for each user (34a-c) on each exercise machine (26) so that the program settings for a particular user (34a-c) on a given exercise machine (26a-d) may be automatically or manually adjusted to accommodate that particular user's (34a-c) changing capabilities. The program settings are typically adjusted automatically as discussed in detail below but may be adjusted manually via the attached keyboard (28c). Program settings, as used herein, refer to the default settings for a given user on a given exercise machine and will vary from time to time as the capabilities of the particular user vary. The site computer (28a) may be in electronic communication with a WAN (30). Where the site computer (28a) is in electronic communication with a WAN (30), the particular user settings stored in the local

database (28b) are periodically transmitted to an Off-Site Computer database (32b) so that any given user's (34a-c) settings may be retrieved from any exercise site (22).

[0049] As is seen in Figure 2A and Figure 2B, the site exercise circuit system (31) of the present invention is comprised of a plurality of different first site exercise machines (26a-d). It is expected that during the course of a workout routine more than one human user (34a-c) with User ID tags (36a) will utilize substantially all of the exercise machines (26) sequentially in a circuit-like manner as indicated by arrows (35). Additionally, at anytime that the machine is idle, or a user does not have a user ID tag the phantom user will be considered to be using the machine. For example, after completing an exercise period on Exercise Machine 1 (26a), the particular user (34a) will proceed to Exercise Machine 2 (26b) to commence a new exercise period. The user (34a) will repeat this process until the user has completed his or her workout or has reached the final machine of the circuit (32), Exercise Machine N (26d). Typically, other human users with user ID tags will follow so that most of the exercise machines (26a-d) of the circuit are in use simultaneously, and in use by a phantom user when the machines are idle.

[0050] Each particular user (34a-c) of the circuit carries an identifying tag (36) such as a transponder which enables each exercise machine (26a-d) to uniquely identify each user (34a-c). It is understood that within the scope of the present application, a particular user (32a-b) may carry the identifying tag (36) in his or her hand or attached to a foot or ankle, by wearing the tag, by affixing the tag to clothing or by any other means such that the identifying tag is in close enough proximity such that it may function to uniquely identify a particular user (34a-c) as that user approaches or mounts an exercise machine (26a-d). In the preferred embodiment the identifying tag (34a-c) is a Radio Frequency Identification ("RFID") device, which is well known in the art. An RFID device uses radio waves to automatically identify people or objects. The RFID identifying tags (36) store an identification number which uniquely identifies the particular user (34a-c) on a microchip that is attached to an antenna. In alternate embodiments, other forms of user (34a-c) identification may be utilized. A non-exhaustive set of examples includes cards or other items encoded with bar codes, biometric identification such as fingerprints, or manual code entry on the exercise machine.

[0051] One embodiment of the invention utilizes an RFID identification system, it should be understood that a RFID system is just one of many acceptable systems capable of providing the needed identification of a user. For example, a RFID tag in the shape of a ring (315) can be worn by the user, as shown in Figure 3A and Figure 3B. The RFID ring uses a 125kHz RFID tag, model 1775 from RFID, Inc., Aurora, CO. Briefly, the RFID tag is a 12mm long x 2mm diameter glass ampoule tag (320) similar to those used in animal identification. It can be attached rigidly to a plastic or metal ring (310) and worn by the user. Alternatively, the RFID tag can be sewn into an elastic band (330) and slipped onto the user's finger.

[0052] Each exercise machine (26a-d) of the present invention is equipped with a tag reader (38). Generally, the tag reader (38), or interrogator, transmits electromagnetic waves which the antenna on the identifying tag (36) is tuned to receive. The identifying tag (36) draws power from the field created by the tag reader (38) and uses it to power the microchip's circuits which then modulate the waves that the identifying tag (36) sends back to the tag reader (38) a signal which uniquely identifies the identification tag (36) and thereby uniquely identifies the user (34a-c). The transmission of electromagnetic waves by the tag reader (38) creates a proximity zone (40) about the exercise machine (26), or about the tag reader on the exercise machine, within which a user (34a-c) may be uniquely identified. The size of the proximity zone (40) depends upon the frequency of operation, the power of the tag reader (38), and interference from other objects. It is expected that the proximity zones (40) of the present invention will extend about and beyond the tag reader of the exercise machines (26) but not so far as to overlap with the proximity zones (40) of other exercise machines (26). In a preferred embodiment, the user ID tag reader (340) is mounted near one of the exercise machine's hand grips (350), such that the user ID tag reader is activated when the user places the user ID tag ring (315) on or near the hand grip, as shown in Figure 3B. For example, a Model 3020 "MicroReader" (from RFID, Inc.) operating at 125kHz has been used as a preliminary prototype. The antenna for the tag reader has been integrated into the handle of the exercise equipment. The tag reader communicates with the real-time controller via an RS232 serial communication channel at a speed of 9600 baud. Although not wanting to be bound by theory, it is possible to incorporate the tag reader's functionality into the real-time controller, which could reduce the number of separate units used.

[0053] When a user (34a-c) enters the proximity zone (40) of an exercise machine (26), the tag reader (38) of the exercise machine (26) receives a signal which provides an identification number which uniquely identifies the user (34a-c) as being different from the default or phantom user. The exercise machine (26) transmits this identification number to the site computer (28a) via the LAN (30) to request the program settings for that user (34a-c) on that type of exercise machine (26). Once the user's (34a-c) settings are located in the local database (28b), the settings are transmitted back to the exercise machine (26) which configures itself accordingly. The program settings for a given user (34a-c) on a given exercise machine (26) may include any setting which affects the ease or difficulty with which an exercise machine is utilized by the user. For example, for an elliptical exercise machine, the settings may include resistance, incline, and/or programming to vary resistance and incline during the exercise period. As an alternate example, a programmable electronic weight resistance system's program settings may include the initial resistance and the distance the actuator bar is placed from the user. If the user (34a-c) is not defined in the local database (28b), a signal is transmitted to the exercise machine (26a-d) that the current user is not defined within the exercise system (10) and to configure itself with device default settings stored within an on-board microcomputer (not shown). Generally, the device default settings for an undefined user are the same as the phantom user and will reflect an average of the capabilities of users known to the enterprise circuit exercise system (10). When the user removes the user ID tag from the ID tag reader the machine will detect a change of users and the phantom user will become the current user until another user ID tag is detected indicating another change of user.

[0054] Where the exercise site (20a-b) is connected to a WAN, new data from the exercise site's (20a-b) local database (28b) is propagated to the Off-Site Computer database (32b) via the Off-Site Computer (32a). New data, as used herein, refers to any user (34a-c) data of any sort that has been created or modified since the last propagation of data from the local database (28b) to the Off-Site Computer database (32b). Typically, the propagation of data from the local database (28b) to the Off-Site Computer database (32b) occurs at regular intervals; for example, once daily. Once the new data from each of the exercise sites (20a-d) has been incorporated into the Off-Site Computer database (32b), the complete set of data for all exercise sites (20a-d) is propagated back down to the local

database (28b) for each exercise site (20a-d). In this manner, a user from any exercise site may utilize any other exercise site and still have access to his or her program settings.

[0055] When the user's (34a-c) settings are received by the exercise machine (26), to confirm to the user that the exercise machine (26) is properly configured for that user, the user's (34a-c) name and/or serial number will be graphically displayed on the exercise machine display device (42). See Figure 3C for a more detailed view of the exercise machine display device (42). When a phantom user or an undefined user is operating the exercise machine (26), the exercise machine display device (42) presents an indication that the system device default settings have been used to configure the exercise machine (26). Alternatively, the exercise machine may have a non-graphic display device. A non-graphic display means include an indicator light (421) (where one type of light is used to indicate that the user ID tag has been recognized while the other type of light is used to indicate that the user has not been recognized, and is thus a "phantom," or undefined user). Another type of non-graphic indicator may be an acoustic feedback device (e.g. speaker (420)) for transmitting a voice or sound indicator. Furthermore, a combination of graphic and non graphic devices may be present on a single exercise machine (42), (420), and (421). The user ID tag reader (340) is mounted near one of the exercise machine's hand grips (350). In order to operate the displays, user ID tag reader and other electronics located at the exercise machine, power may be supplied using a battery or power cable. However, in order to reduces cable clutter power may be supplied to the machine via the same signal path as data is transmitted back and forth using the "power-over-Ethernet" standard IEEE 802.11af.

[0056] Upon removal of the user ID tag from the ID tag reader on a particular exercise machine (26a-d) by the user (34a-c), statistics related to that exercise period are transmitted to the site computer (28a) for storage in the local database (28b). The statistics transmitted may include number of repetitions, average/peak forces and velocities, maximum displacement of a moving part, total energy expended, or any other use-related statistic that may be useful in tracking a user's development. These statistics are aggregated by the on-board microcomputer (not shown). Periodically, as discussed below, the site computer (28a) will utilize the use statistics stored in the local database (28b) for a user (34a-c) to amend the program settings for that user on an exercise machine (26a-d) to tailor a user's (34a-c) workout routine to the changing capabilities of that user. Further, a

user (34a-c) may manually adjust his or her program settings through data input on attached keyboard (28c).

[0057] As mentioned above, at all times, each exercise machine has a current user. When a human user having a user ID tag is detected, the machine settings for that user's profile are loaded on the machine that has detected that particular user ID tag. Alternatively, when an ID tag is not identified by the exercise machine, a phantom user having default settings is considered to be using the machine. Flow diagrams showing the user identification and usage tracking of an exercise machine are shown in Figure 4A and Figure 4B. Figure 4A shows a method for user identification and communication between the RFID system and the database without a cache, and Figure 4B shows a similar system with a cache. One advantage of having a system with cache is that once a user ID tag is identified and the user's profile is retrieved from the database, all the user's settings for each and every machine in the circuit can be transmitted and stored on the cache of each separate exercise machine rather than accessing the local area network each time the user changes. Because there is always an active user on the machine, either a user with the User ID tag or a phantom user, each machine always has a phantom user profile loaded, which allows a rapid change of users. By using a local cache on the exercise equipment the speed with which a user's profile settings can be loaded into the real-time controller is nearly instantaneous. If the profile exists in the cache, no latency is incurred by requesting the profile over the LAN and waiting for the site computer to look up the profile and transmit it back to the controller. Additionally, the use of local cache makes the system of exercise machines and controllers more tolerant of temporary LAN disruptions. However, using a local cache requires that the real-time controller have a large enough memory to hold the profiles for many users (e.g. about 25), which translates to a more expensive model of microprocessor in the controller design.

[0058] This process executes in a continuous loop while the exercise machine is in operation. When the equipment is initially turned on and no user ID tag has been identified, the machine is being used by the phantom user as a default. The tag reader of the exercise machine repeatedly transmits a signal to locate a user ID tag of a user (step 52). The tag reader transmits the interrogation signal to locate the user ID tag in the range of about hundreds of times per second to about once every few minutes. The preferred rate for tag interrogation is anywhere from 100 interrogations per second down to once

every few minutes. Generally, tags are interrogated about 10 times per second, however, some system designed for situations other than circuit training may not need such a fast interrogation rate.

[0059] When a particular user having the user ID tag is found (step 54), the previous users statistics are transmitted to the database, even when the previous user is the phantom user and the particular user's identification number and the machine type are transmitted to the site computer to retrieve the user's program settings for that exercise machine type (step 56). If the exercise machine has cache, it will be checked for the user ID and settings (step 560). When the profile is loaded in cache the user information will be displayed (step 64) and the machine will be configured for exercise. If the profile is not loaded in cache, the user ID and machine type will be transmitted to the database (step 562), where the profile will be retrieve and used to display the user information, or the default settings will be retrieved (step 60). If the exercise machine does not have cache, the existence of the user profile in the database will be determined (step 58). Figure 4C shows a detailed flow diagram of the decision tree "does the profile exist in the database?" in Step 58.

[0060] If the user is not defined for the exercise machine (as set out in more detail below), the device default settings for the exercise machine are retrieved (step 60), and the user's personal information (e.g., name, identification number) are displayed on the exercise machine display device to indicate to the user that the machine is properly configured for that user (step 64). Alternately, non-graphical indicator devices can communicate to the user that the machine has retrieved the user's profile. The exercise machine then configures itself for use by the user with the settings retrieved (step 66). After the exercise machine is properly configured, the user commences the exercise period on the exercise machine (step 68). During the exercise period, the user's use of the exercise machine is tracked (step 70). The variables tracked by the exercise machine may include number of repetitions, average/peak forces, and velocities, maximum displacement of a moving part, total energy expended, user's heart rates, calories burned, or a mixture thereof, or any other use-related statistic that may be useful in tracking a user's development.

[0061] When the user removes the user ID tag from the ID tag reader, the exercise machine will detect that the user has changed to the phantom user. The phantom user profile will be transmitted to the exercise machine from the database or from the cache memory and the phantom user's usage will be tracked, even when the machine is not actively being used.

[0062] One desired characteristic of the present invention is that it be reliable and as robust as feasible against the possibility of component failures. One subsystem that is most likely to fail occasionally is the Local Area Network ("LAN"). If this happens, it may not be possible for an exercise machine to retrieve a given user's machine settings, nor to identify that user, as the machine's real-time controller is out of contact with the site computer on which resides a database of users and user profiles. To mitigate this problem, a modification of the preferred embodiment includes a local data cache in each machine's controller. As seen in Figure 4B, when a user's tag is successfully read by the machine's tag reader, the local cache is first checked to see whether it contains that user's profile information. If so, then the controller does not attempt to utilize the LAN until the user disembarks from the machine. If not, then the controller attempts to retrieve the user's profile settings via the LAN. When the LAN is fully operational, a profile request from any given machine is transmitted over the LAN to the site computer. The site computer then broadcasts that user's profile and settings to all exercise machine controllers listening on the LAN. Each controller stores this information in its cache. This is a particularly successful modification of the preferred embodiment when used in a circuit-training environment because it is highly likely that each user will use most or all of the machines; if the cache is designed to hold as many user profiles as there are machines in the circuit, then each user's profile is requested via the LAN only once per workout. Thus, a minimum number of users will be incorrectly identified, or lose access to their profiles and settings, if a temporary network failure occurs.

[0063] The probability of previous user still using the machine could be determined as set out in more detail below and in Figure 5. The exercise machine determines whether the user has changed using the decision tree of step 54 in Figure 4A or 4B. Figure 5 is a flow diagram showing a system of determining whether a user with a user ID tag is currently utilizing an exercise machine. It is a decision tree asking if the user has changed. The tag reader of the exercise machine transmits a signal to locate an

identification tag of a user. Using the response received (i.e., identification tag present or not), the prior responses received, and the current state of the exercise machine, the probability that the user is still using the machine is calculated (step 84). The determination of the probability that a user is still using the exercise machine even in the absence of return signal to the tag reader is needed to reduce the possibility that "false negatives" resulting from the tag reader's queries will result in the exercise machine being returned to its default state. In those cases, the user may still be using the exercise machine even when the tag reader does not locate and identification tag.

[0064] If the probability that the user is still using the exercise machine exceeds a certain threshold (step 86), 50% for example, then the exercise machine assumes that the user is still using the exercise machine and continues to gather usage statistics (step 88). Otherwise, the exercise machine ceases gathering usage statistics (step 90) and transmits the gathered statistics to the site computer.

[0065] The probability that the user that began an exercise period is still using an exercise machine is determined using a probability function. An example of such a probability function is

$$P_{new} = (1 - \alpha)\, P_{old} + \alpha U$$

$$U = A \text{ or } (B \text{ and } [C_1 \text{ or } C_2 \text{ or } \ldots \text{ or } C_n])$$

where,

A = 1 if the tag reader retrieves the current user's identification number, 0 otherwise;

B = 1 if the previous reading retrieved the current user's identification number, 0 otherwise;

C_n=1 if the Machine Operating variable exceeds a predetermined threshold, 0 otherwise;

α=a number between 0 and 1.

[0066] Figure 6 is a flow diagram showing one embodiment of the system of updating a user's settings for a particular machine once that user has completed an exercise on that machine. When a user's exercise period on an exercise machine is completed, that machine transmits to the site computer via the LAN usage statistics for that user on that exercise machine during that exercise period (step 102). These usage statistics are then stored in the local database for review (step 104). If it is not the appropriate time to update the user's program settings (step 106) then the process is terminated.

[0067] Several methods have been contemplated by the inventors in order to determine if the current exercise settings are acceptable or need to be revised. First, the settings could be modified if a predetermined amount of time has passed since the last modification. Second, the settings could be modified if the user used a given machine a predetermined number of times.

[0068] One embodiment of the system has a display with a pacing bar. The user is instructed to move a particular component of the machine so that the sensed motion matches the pacing display. The pacing bar oscillation frequency can be increased, which makes the user work faster (and thus harder). One possible statistic to keep track of the pace is the tracking error, which is the difference between the pacing display and the user's actual motion, and modifies the settings if the tracking error falls below a predetermined threshold, which is another method to determine if the current exercise settings are acceptable or need to be revised.

[0069] Additionally, some users may have different goals for their workout routine. Specifically, some users may wish to exercise for strength building, while others for cardiovascular improvement. Still others may wish to switch between the two styles of exercise, so settings could be modified if the user needs to switch between a strength or cardio style exercise. This may be accomplished on machines with adjustable resistance elements such as hydraulic cylinders, a control signal may be sent to the resistance element to, for example, slightly constrict a hydraulic fluid path using a motorized valve, which makes the user work harder.

[0070] One possible sensor that could be mounted on an exercise machine is a heart-rate monitor, whereby the settings could be modified if the user's heart rate rises above (or falls below) a predetermined threshold.

[0071] The timing of the review of a user's program settings for an exercise machine may vary from machine type to machine type, site to site, and user to user. One way of determining the appropriate timing of a review is to review a user's program settings against his or her usage statistics after a fixed number of periods of exercise. By this method, a user's program settings may be reviewed after every fifth or tenth exercise period. Another way of determining the appropriateness of program settings review is to rely upon the most recent usage by the user. For example, if on a given exercise machine the user exceeded fifteen repetitions during an exercise period or failed to achieve ten repetitions during an exercise period, then a review of that user's program settings would be appropriate.

[0072] If the system determines that it is appropriate to review the user's program settings (step 106), the user's program settings are analyzed in reference to the user's usage statistics to determine if the program settings are currently set properly or need to be adjusted (step 110). If the program settings are appropriately set (step 112) then the process is terminated (step 114). If the program settings are too easy for the user's current capabilities (step 116), then the program settings are adjusted to make them incrementally more difficult for the user (step 118). If the program settings are too difficult or too strenuous for the user's current capabilities (step 116), then the program settings are adjusted to make them incrementally less difficult for the user (step 120). Additionally, as seen in Figure 2A, a user or instructor may manually adjust a user's program settings via the keyboard (28c) attached to the site computer (28a).

[0073] Referring now to Figure 7 which illustrates the system of retrieving a user's settings for a particular machine once that machine has identified the user. It is a decision tree asking the question: Does the profile exist in the database? As used herein, "profile" means the entire collection of settings, user ID number, user's name, date the user last used the exercise machine, and other relevant information pertaining to that particular user. A request sent by an exercise machine and received by the site computer via the LAN to retrieve the program settings for a given user on a given exercise machine

type (step 122). The site computer queries the local database for the user's program settings using the user identification and exercise machine type (step 124). If the program settings are found (step 126), the site computer retrieves the settings from the local database (step 130) and returns those settings and a flag indicating that the user's settings were located to the requesting exercise machine (step 132). If the program settings for the user are not found in the local database (step 126) then a flag is returned to the exercise machine indicating that the user's settings were not located (step 128).

[0074] The invention is illustrated by example in the drawing figures, and throughout the written description. Although the invention has been described with reference to specific embodiments, this description is not meant to be construed in a limited sense. Various modifications of the disclosed embodiments, as well as alternative embodiments of the invention will become apparent to persons skilled in the art upon the reference to the description of the invention. It is, therefore, contemplated that the appended claims will cover such modifications that fall within the scope of the invention.

EXAMPLE 2

[0075] One large commercial workout establishment's routine is simple yet varied. Gym members use exercise machines arranged in a circle, known as a circuit training. The exercise machines are used at 30 second intervals. When prompted, the members switch to the next station in the circuit for a workout session of 30 minutes. Figure 8 shows a typical layout of circuit training machines.

[0076] One general objective of the invention is to have a system that can obtain and update a user's workout profile during a user's workout. The general method to achieve this objective utilized a real-time controller, a radio frequency identification tag ("RFID") for user identification with visual feedback, a hydraulic cylinder to provide resistance, and a linear displacement sensor attached to the hydraulic cylinder. For example, a leg extension machine was one specific machine that incorporated the invention. As shown in Figure 9, (900) shows a leg extension machine (930) having an LCD, a hydraulic cylinder (940), a linear displacement sensor (910), and a RFID tag reader (950) was used to demonstrate the specifications of this invention. The linear displacement sensor (940) measures the total amount of linear motion recorded at the

cylinder, from which the user's total range of physical movement may be inferred. Such displacement measurements may be obtained by sensors such as a Linear Variable Differential Transformer ("LVDT") or a Linear Magnetostrictive Sensor, both of which are well known in the field. Furthermore, by periodically sampling the output of the linear displacement sensor (for example, once every 1/100 of a second), the velocity of the hydraulic cylinder's piston may be accurately approximated. In this embodiment, the hydraulic cylinders exhibit a well-known mathematical relationship between the piston velocity and the resistive force generated by the cylinder. Thus, the real-time controller may accurately approximate the force with which the user is actuating the cylinder. Knowing the force and velocity experienced by the user permits direct calculation of the amount of work or average power expended during the exercise.

[0077] The embodiments shown and described above are only exemplary. Even though several characteristics and advantages of the present invention have been set forth in the foregoing description together with details of the invention, the disclosure is illustrative only and changes may be made within the principles of the invention to the full extent indicated by the broad general meaning of the terms used in herein and in the attached claim.

REFERENCES CITED

[0078] The following references, to the extent that they provide exemplary procedural or other details supplementary to those set forth herein, are specifically incorporated herein by reference.

U.S. PATENT DOCUMENTS

United States Patent Application 09/776,410; Publication No.: 2002/0022551 filed by Watterson, Scott R. on February 2, 2001 and titled "Methods and Systems for Controlling an Exercise Apparatus Using a Portable Remote Device," "the '410 Application").

United States Patent Application 10/819,052; Publication No." 2004/0198555 file by Anderson, Brent on April 6, 2004 and titled, "Health Club Exercise Records System,"

United States Patent 5,931,763 filed by Nerio Alessandri on February 24, 1998 and titled, "System for Programming Training on Exercise Apparatus or Machines and Related Method."

United States Patent 6,659,946 filed by Stephen Batchelor on June 30, 2000 and titled, "Training System."

United States Patent 6,702,719 filed by Brown, Michael Wayne on April 28, 2000 and titled, "Exercise Machine."

WHAT IS CLAIMED IS:

1. A system for providing identification, or identification together with programmed training, for a particular user out of multiple users, the system comprising:

at least one exercise machine equipped with a user identification device;

an identification system; and

a storage database;

wherein,

the identification of the particular user is accomplished automatically;

the programmed training is accomplished automatically or manually; and

the identification system is in communication with the storage data base, whereby settings of the particular user can be transmitted to, and retrieved from, the storage database.

2. The system of claim 1, wherein the identification system is a radio frequency identification ("RFID") system.

3. The system of claim 2, wherein the RFID system comprises an RFID tag and an RFID antenna.

4. The system of claim 2, further comprising a communication network to facilitate communication between the RFID system and the storage database.

5. The system of claim 1, wherein the settings of the particular user retrieved from the storage database are used to alter a state of the exercise machine.

6. The system of claim 1, wherein settings of the particular user retrieved from the storage database are displayed visually.

7. The system of claim 1, wherein the exercise machine is an adjustable-resistance machine and the settings of the particular user retrieved from the storage database are used to adjust resistance of the adjustable-resistance machine.

8. The system of claim 1, wherein the exercise machine has a display with a pacing bar and the settings of the particular user retrieved from the storage database are used to prompt the user to move a particular component of the exercise machine so that a sensed motion matches the display with the pacing bar.

9. The system of claim 1, wherein the system is used in a circuit training.

10. The system of claim 1, wherein the user identification device is a tag reader.

11. The system of claim 1, wherein the exercise machine is adapted to include a microcomputer to facilitate communication, processing, data storage, and retrieval needs of the system.

12. The system of claim 1, wherein the exercise machine is equipped with a caches memory for storing profile of the particular user.

13. The system of claim 1, wherein the storage database is in communication with the exercise machine through a network.

14. The system of claim 13, wherein the network is a local area network ("LAN") or a wide-area network ("WAN").

15. The system of claim 1, wherein the exercise machine has at least one sensor from which measurements from the particular user can be collected and transmitted to the storage database.

16. The system of claim 15, wherein the measurements comprise angular or linear displacement of a moving part of the exercise machine, the force with which the particular user exercises, the velocity with the particular user exercises, the number of repetitions preformed by the particular user, heart rate of the particular user, number of calories burned by the particular user, or a combination thereof.

17. An exercise system capable of obtaining and updating a particular user's workout profile during the particular user's workout, the exercise system comprising:

a real-time controller;

an identification system;

a resistance-producing device; and

a displacement sensor, attached to the resistance-producing device, for measuring total amount of motion recorded at the resistance-producing device, the displacement sensor being connected to the real-time controller through a first communication channel;

wherein, the real-time controller is adapted to approximate a force with which the particular user is actuating the resistance-producing device.

18. The exercise system of claim 17, where the identification system is a radio frequency identification ("RFID") system communicating with the real-time controller through a second communicating channel.

19. The exercise system of claim 17, wherein the resistance-producing device is an adjustable resistance-producing device connected to the real-time controller through a third communication channel.

20. The exercise system of claim 17, wherein the resistance-producing device is an exercise machine of a hydraulic cylinder, a weight machine, a spring, or a combination thereof.

21. The exercise system of claim 17, wherein the displacement sensor is a linear displacement sensor and the total amount of motion recorded at the resistance-producing device is a linear motion.

22. A method for automatically identifying, monitoring, and interfacing exercise machine information and database information for at least a first user and a second user having at least a programmable exercise machine equipped with a user identification device and a database comprising:

(a) configuring a first user ID number into the programmable exercise machine, wherein the first user ID number is a default profile having a predetermined difficulty setting for the programmable exercise machine;

(b) automatically detecting a presence or absence of a user identification tag with the user identification device, wherein the absence of the user identification tag automatically designates the user as having a first user ID number; and the presence of the user identification tag automatically designates the user as having the second user ID number;

(c) repeating step (b) if the first user ID number is determined, or continuing to step (d) if the second user ID number is determined;

(d) querying the database information to determine if at least a second profile exists for at least the second user ID number;

(e) repeating step (a) if the second user ID profile does not exist; or continuing to step (f) if the second user profile exists;

(f) configuring a second user ID setting obtained from at least the second user profile into the programmable exercise machine, wherein the second user ID settings are an editable profile having a second difficulty setting determined by at least the second user;

(g) repeating step (b); and

wherein, the exercise machine is in data communication with a database.

23. The method of claim 22, further comprising, tracking usage data of the programmable exercise machine after step (f) to be transmitted to the database as an updated second user ID setting when the second user is no longer exercising.

24 The method of claim 23, further comprising determining if the second user no longer exercising by calculating a probability function comprising:

$$P_{new} = (1 - \alpha)\, P_{old} + \alpha U$$

wherein, $U = A$ or (B and [C_1 or C_2 or … or C_n]); $A = 1$ if a repeated step (b) determines the presence of the second user; and A = 0 if repeated step (b)

determines the presence of the first user; $B = 1$ if the user of the initial step (b) equals the user of the repeated step (b); and B = 0 if the user of the initial step (b) does not equal the user of the repeated step (b); C_n=1 if a machine operating variable exceeds a predetermined threshold, and C_n=0 if the machine operating variable does not exceed the predetermined threshold; α=a number between 0 and 1.

25. The method of claim 24, further comprising selecting the machine operating variable as resistance or repetition.

26. The method of claim 22, further comprising, selecting the programmable exercise machine having cache memory for loading the second user settings and tracking usage data of the programmable exercise machine after step (f); wherein the usage data is transmitted to the database as an updated second user ID setting when at least the second user is no longer exercising.

27. The method of claim 26, further comprising, updating the second user profile with the updated second user ID setting forming an updated second user profile, and wherein the updated user profile comprises statistics related number of repetitions, average/peak forces and velocities, maximum displacement of a moving part, total energy expended, or a combination thereof.

28. The method of claim 22, further comprising, providing the user identification tag as a radio frequency identification ("RFID") tag in a ring shape that is worn by the user, and wherein the user identification device comprises a proximity RFID tag detector that interrogates a presence or absence of the ring.

29. The method of claim 22, further comprising, providing the exercise machine in data communication with a database having a local area network ("LAN") or a wide-area network ("WAN") data communication connection and a site computer or an off-site computer.

30. The method of claim 22, further comprising, providing the exercise machine comprising elliptical machines, stationary bicycles, electronic weight resistance machines, treadmills, stair-step machines, and hydraulic resistance machines.

31. A system for providing identification, or identification together with programmed training, for a particular user out of multiple users, the system comprising:

on at least one exercise machine equipped with a tag reader and a sensor;

a radio frequency ("RFID") system comprising an RFID tag and an RFID antenna; and

a storage database;

wherein,

the identification of the particular user is accomplished automatically;

the programmed training is accomplished automatically or manually;

the sensor can collect measurements for the particular user and transmit the measurements to the storage database,

the identification system is in communication with the storage data base, whereby settings of the particular user can be transmitted to, and retrieved from, the storage database; and

the settings of the particular user retrieved from the storage database are used to alter a state of the exercise machine.

32. An exercise system capable of obtaining and updating a particular user's workout profile during the particular user's workout, the exercise system comprising:

a real-time controller;

a radio frequency identification ("RFID") system comprising an RFID tag and an RFID antenna,

a resistance-producing device comprising a hydraulic cylinder, a weight machine, a spring, or a combination thereof; and

a linear displacement sensor, attached to the resistance-producing device, for measuring total amount of linear motion recorded at the resistance-producing device, the linear displacement sensor being connected to the real-time controller through a first communication channel;

wherein,

the real-time controller is adapted to approximate a force with which the particular user is actuating the resistance-producing device; and

the RFID system is in communication with the real-time controller through a second communication channel.

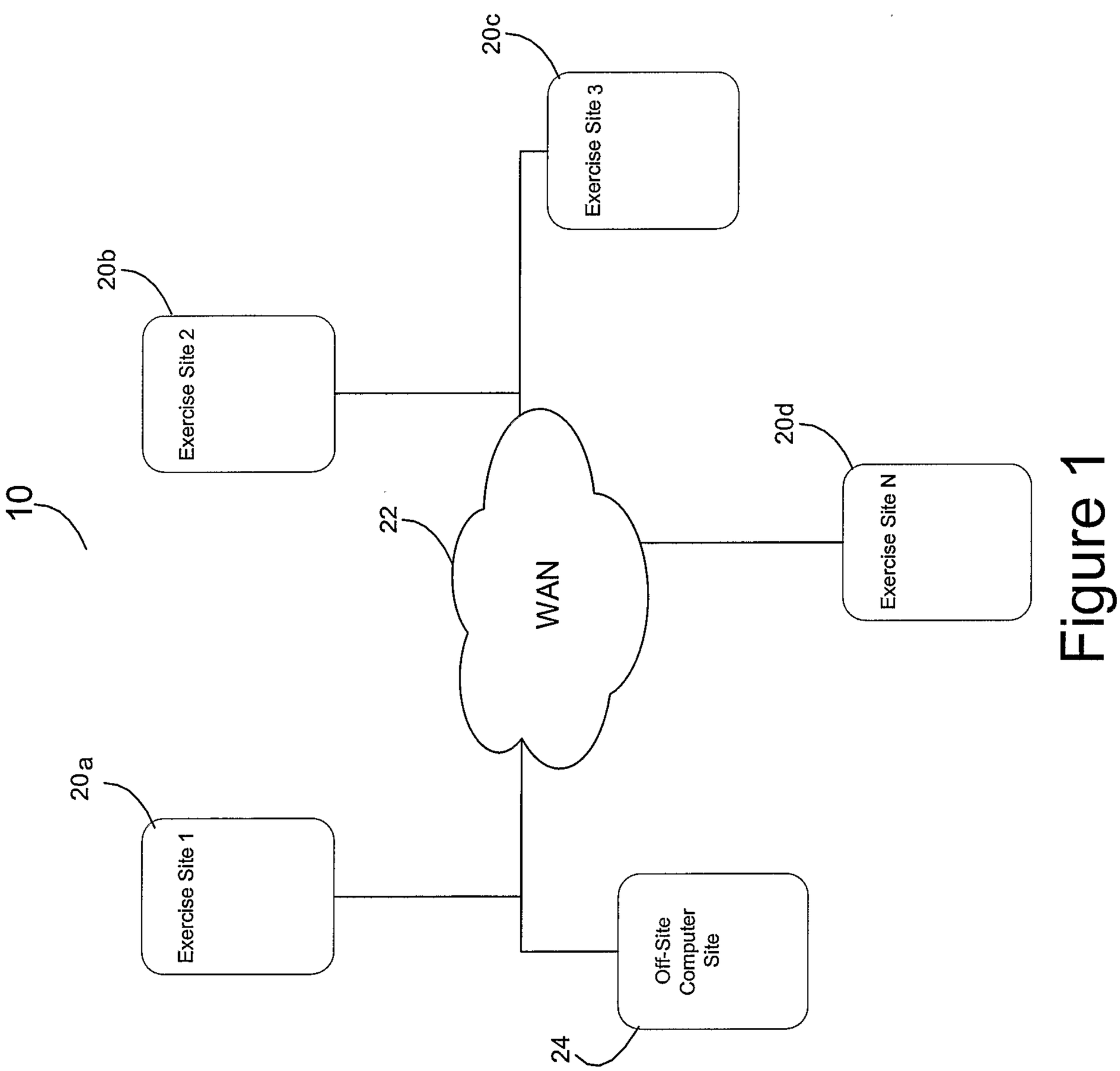

10
Exercise Site 1
20a
Exercise Site 2
20b
Exercise Site 3
20c
Exercise Site N
20d
WAN
22
Off-Site Computer Site
24

Figure 1

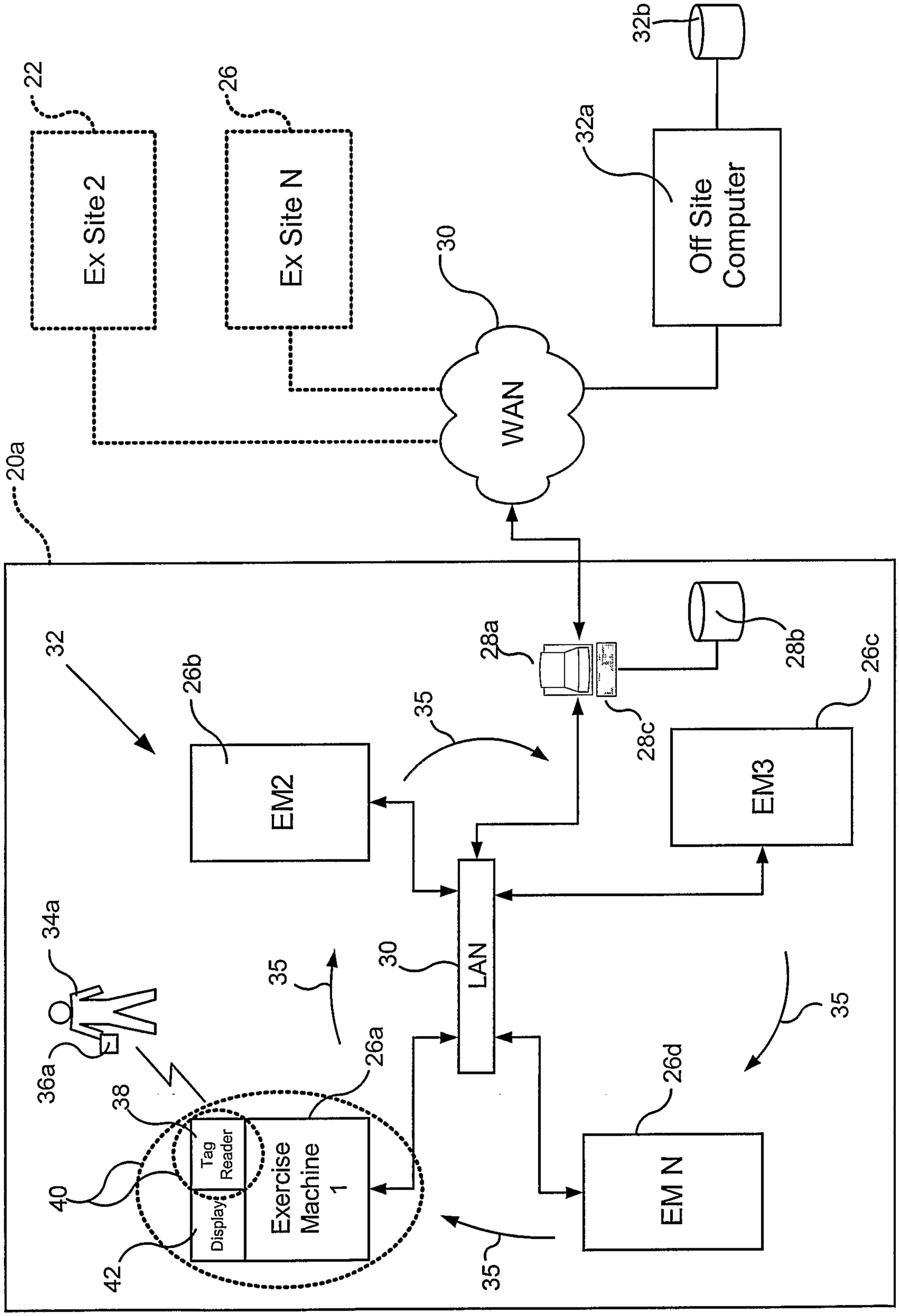

22
Ex Site 2
26
Ex Site N
30
32b
32a
Off Site Computer
WAN
20a
32
26b
28a
28b
26c
28c
35
EM2
EM3
LAN
34a
36a
38
26a
Tag Reader
Display
Exercise Machine 1
40
42
EM N
26d

Figure 2A

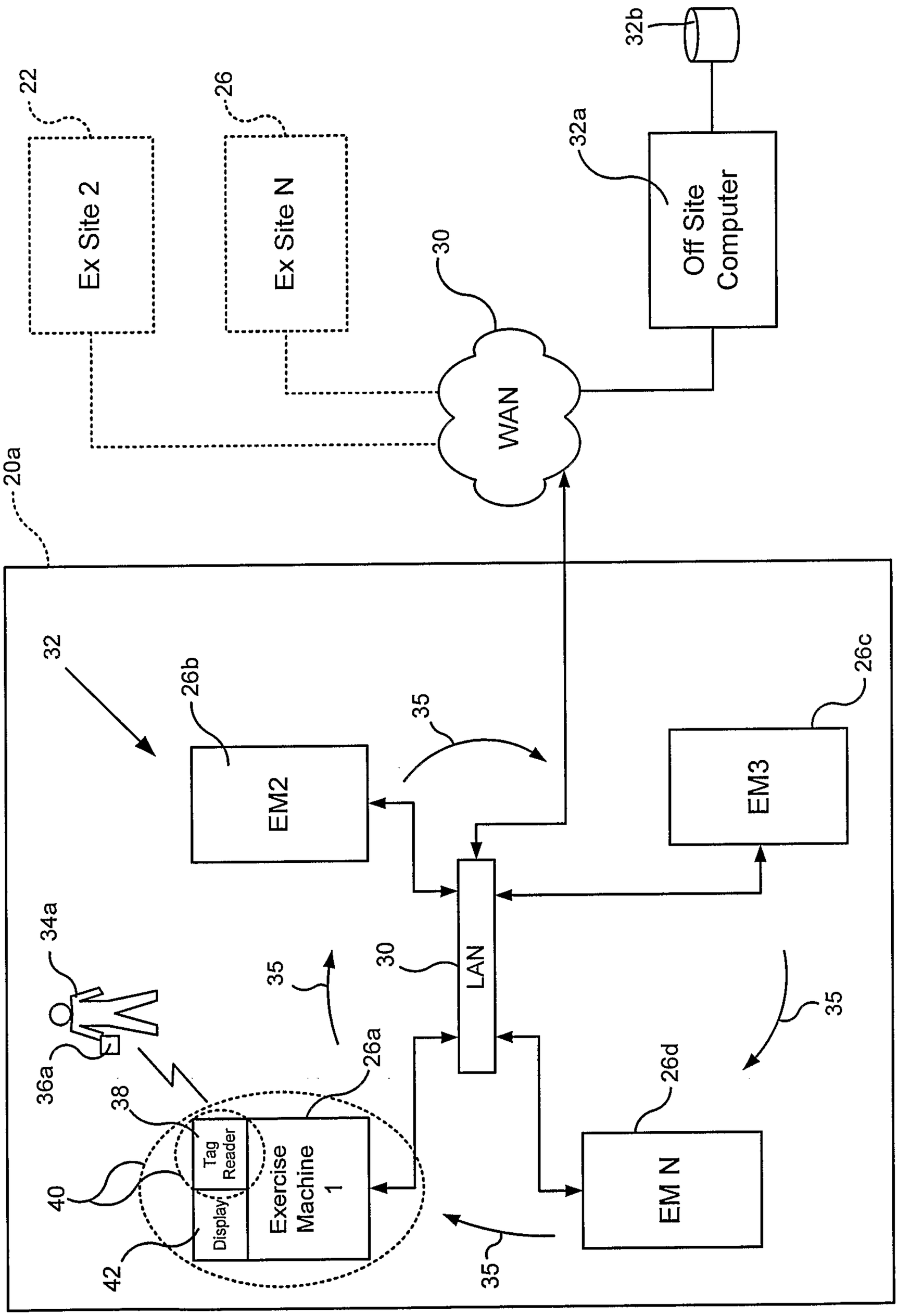

32b
32a
Off Site Computer
22
Ex Site 2
26
Ex Site N
30
WAN
20a
32
26b
EM2
35
26c
EM3
34a
LAN
30
35
35
36a
38
26a
26d
Tag Reader
Display
Exercise Machine 1
EM N
40
42
35

Figure 2B

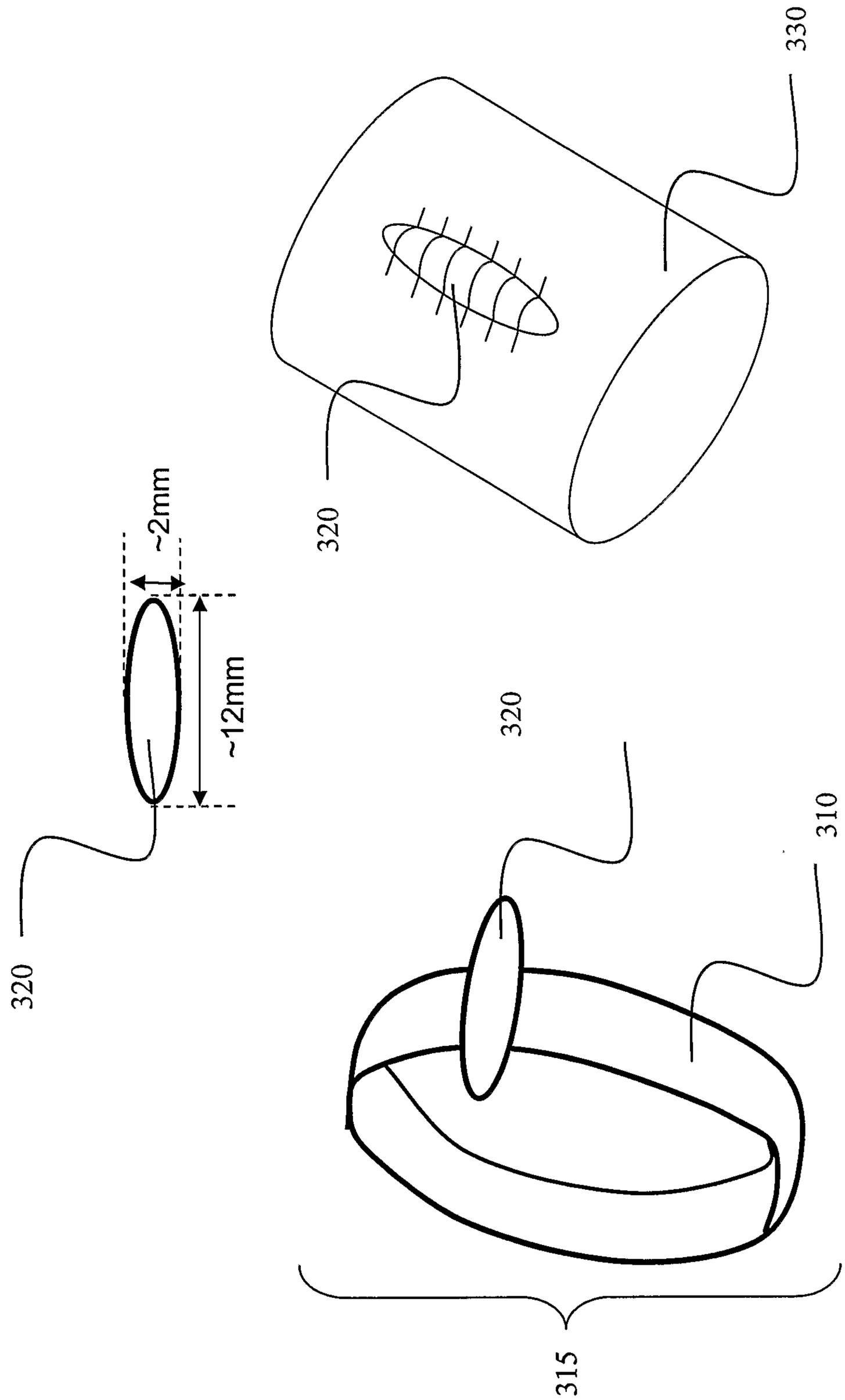


Figure 3A

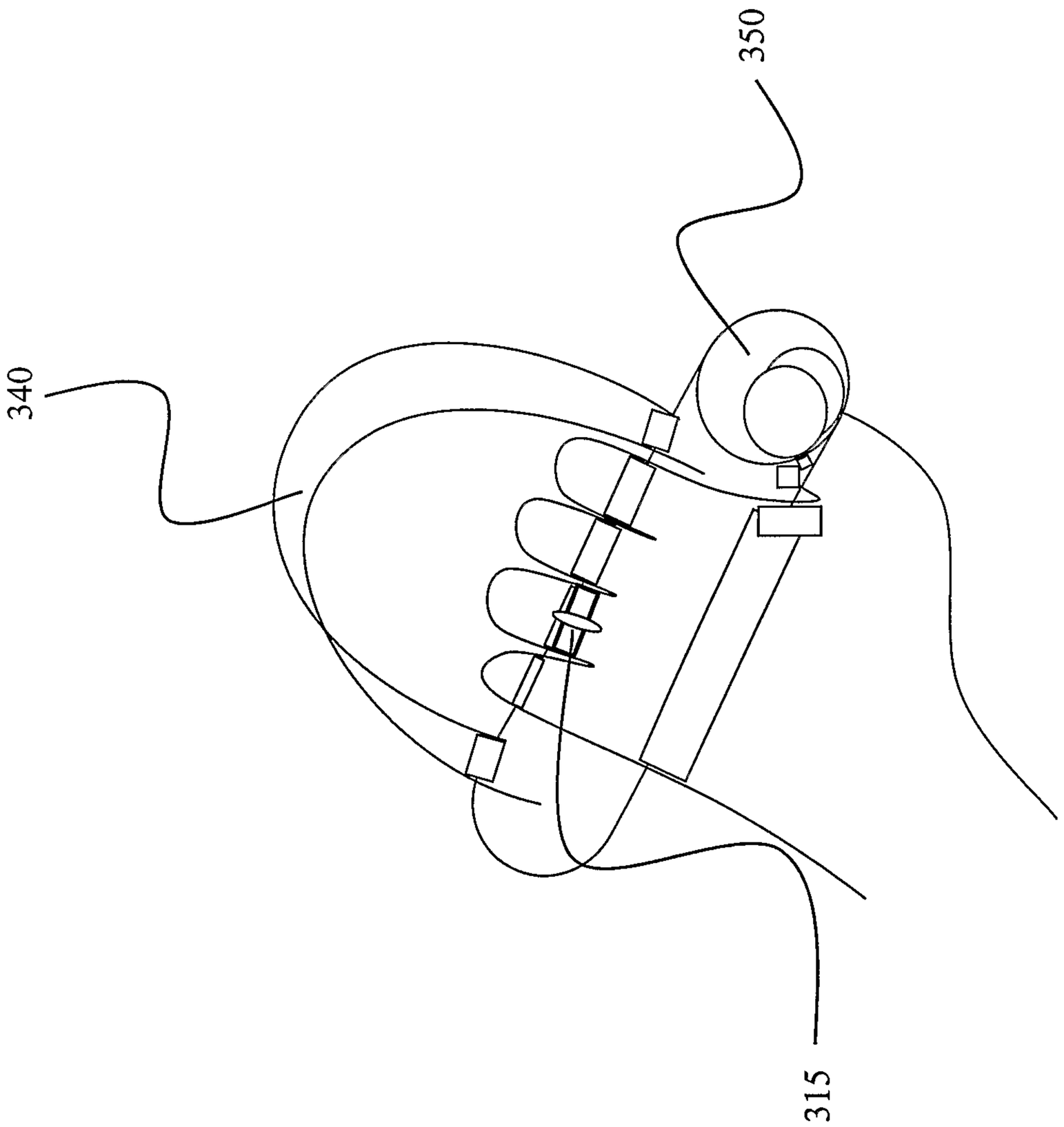


Figure 3B

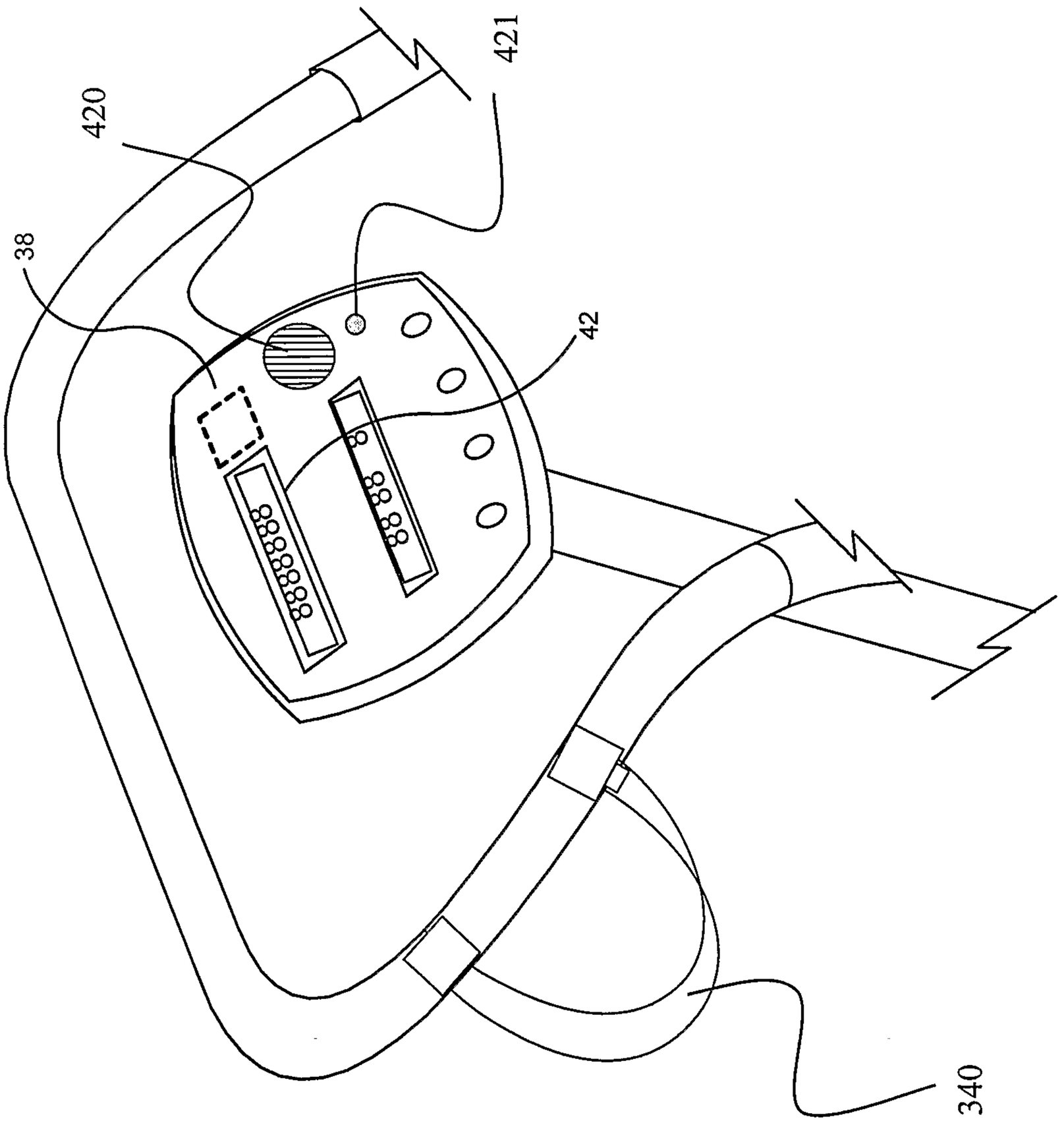


Figure 3C

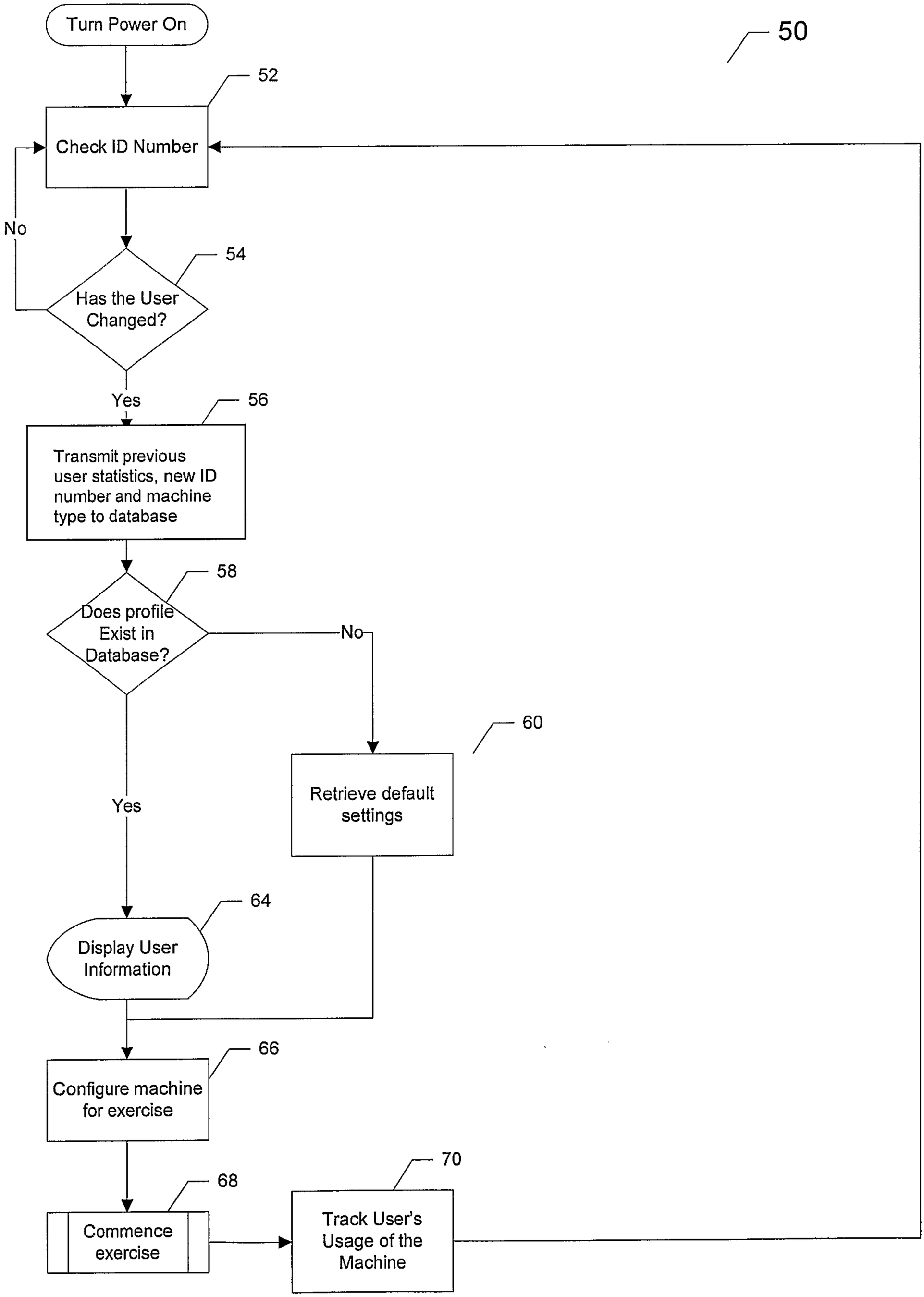

Turn Power On
50
52
Check ID Number
No
54
Has the User Changed?
Yes
56
Transmit previous user statistics, new ID number and machine type to database
58
Does profile Exist in Database?
No
60
Retrieve default settings
Yes
64
Display User Information
66
Configure machine for exercise
68
Commence exercise
70
Track User's Usage of the Machine

Figure 4A

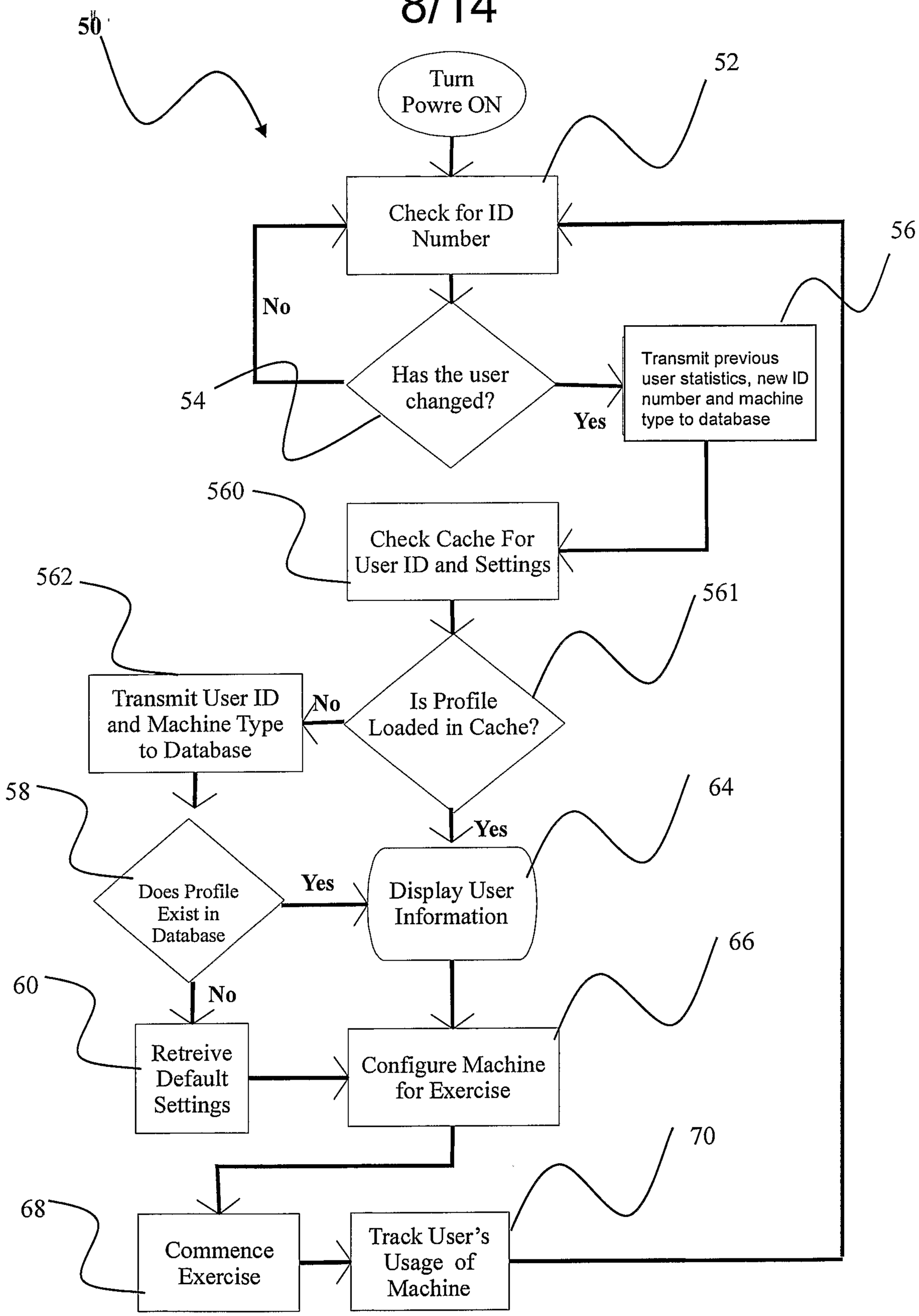

50
Turn Powre ON
52
Check for ID Number
56
No
54
Has the user changed?
Yes
Transmit previous user statistics, new ID number and machine type to database
560
Check Cache For User ID and Settings
562
561
Transmit User ID and Machine Type to Database
No
Is Profile Loaded in Cache?
58
64
Does Profile Exist in Database
Yes
Display User Information
Yes
66
60
No
Retreive Default Settings
Configure Machine for Exercise
70
68
Commence Exercise
Track User's Usage of Machine

Figure 4B

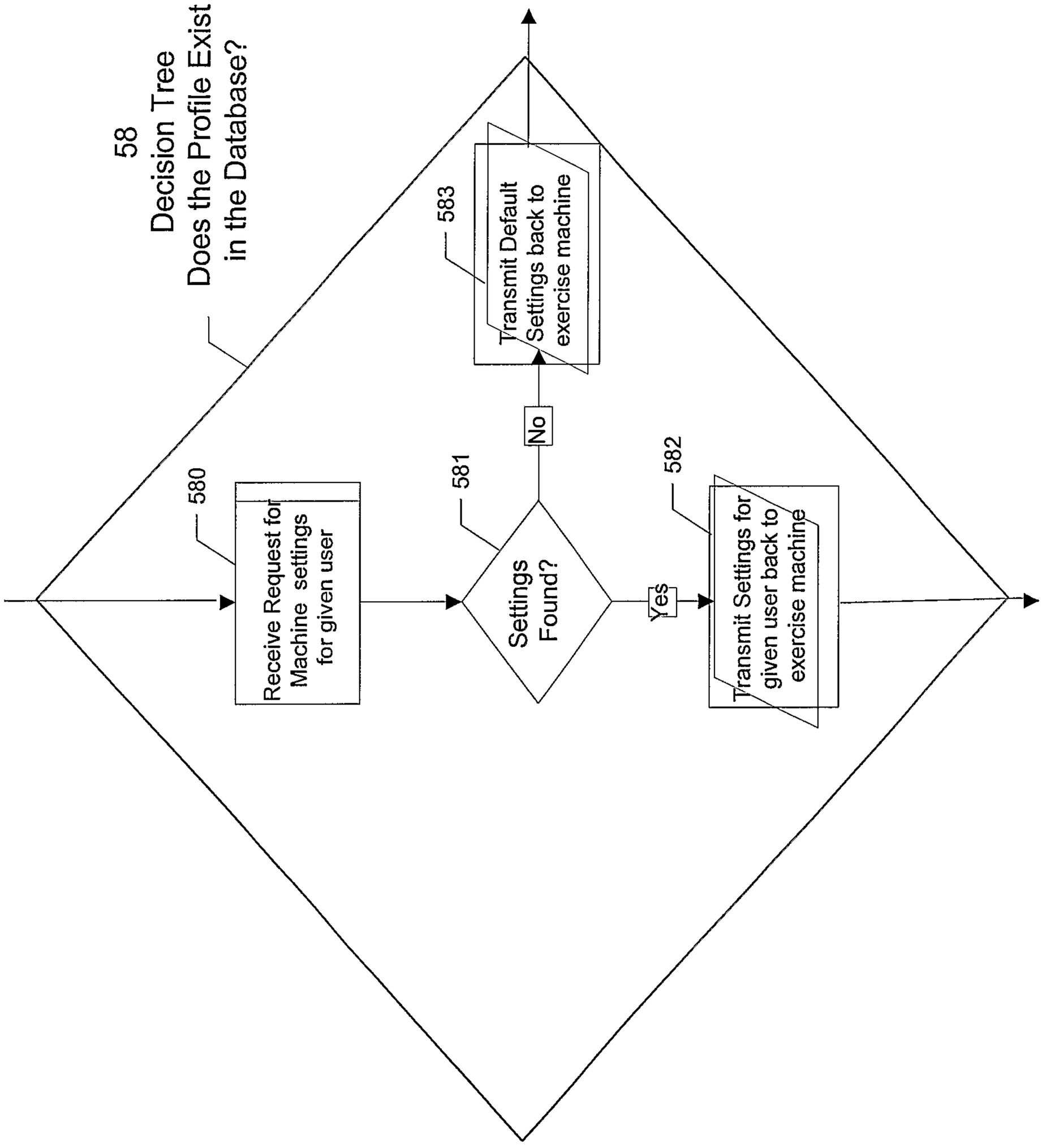

58
Decision Tree
Does the Profile Exist
in the Database?
580
Receive Request for
Machine settings
for given user
581
Settings
Found?
No
583
Transmit Default
Settings back to
exercise machine
Yes
582
Transmit Settings for
given user back to
exercise machine

Figure 4C

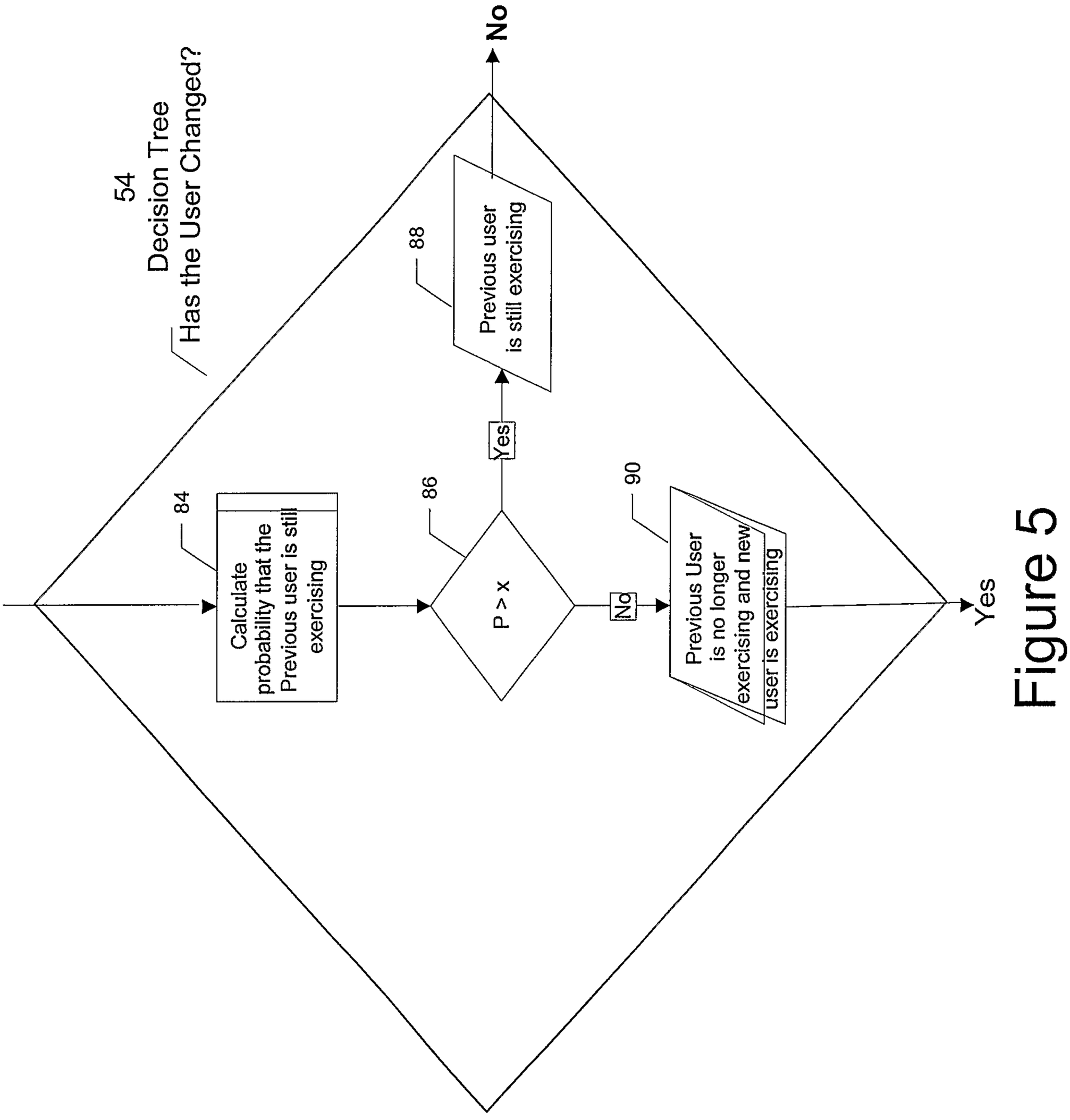

54
Decision Tree
Has the User Changed?
No
84
Calculate probability that the Previous user is still exercising
86
P > x
Yes
88
Previous user is still exercising
No
90
Previous User is no longer exercising and new user is exercising
Yes

Figure 5

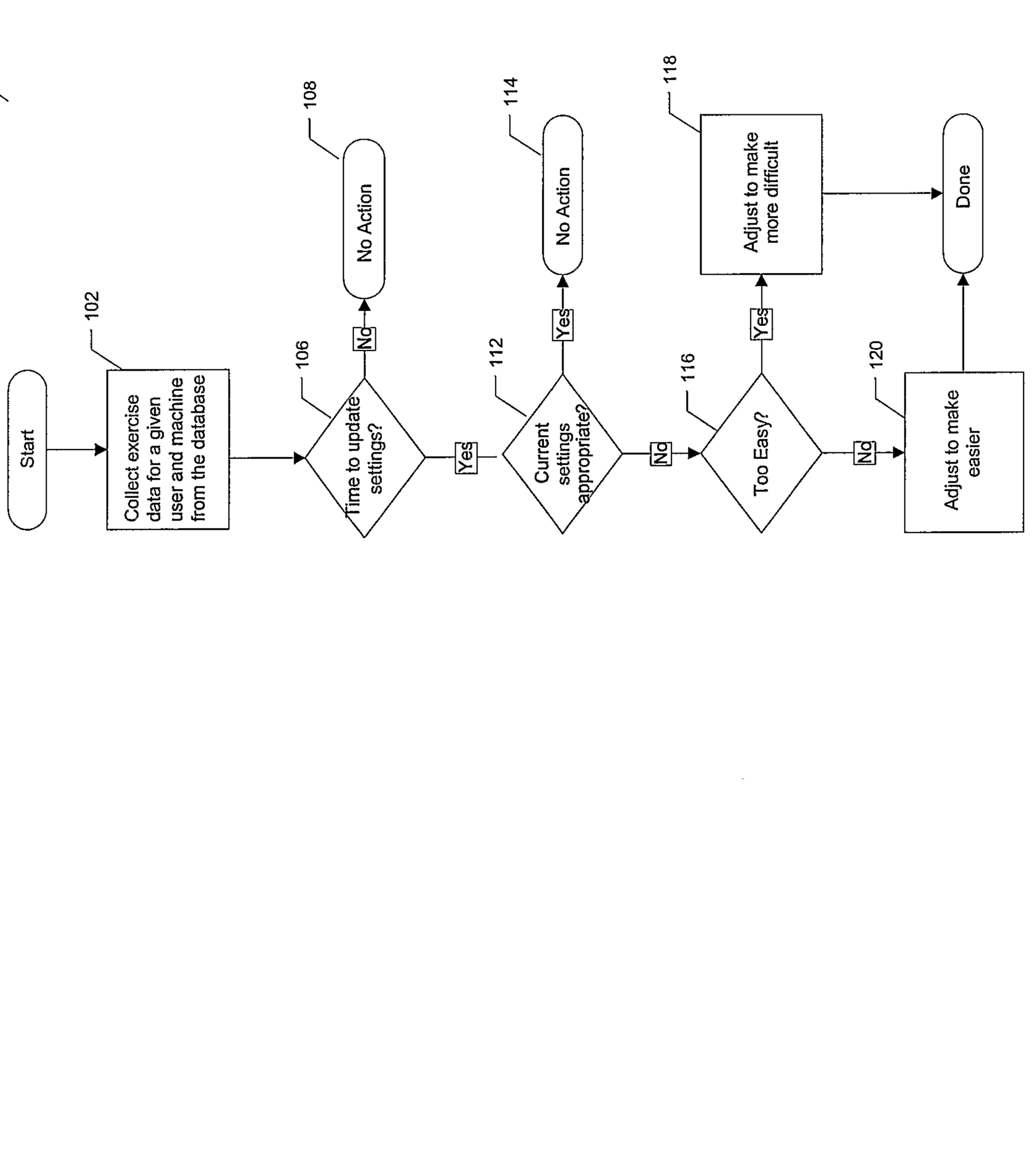

100
Start
102
Collect exercise data for a given user and machine from the database
106
Time to update settings?
Yes
No
108
No Action
112
Current settings appropriate?
Yes
No
114
No Action
116
Too Easy?
Yes
No
118
Adjust to make more difficult
Done
120
Adjust to make easier

Figure 6

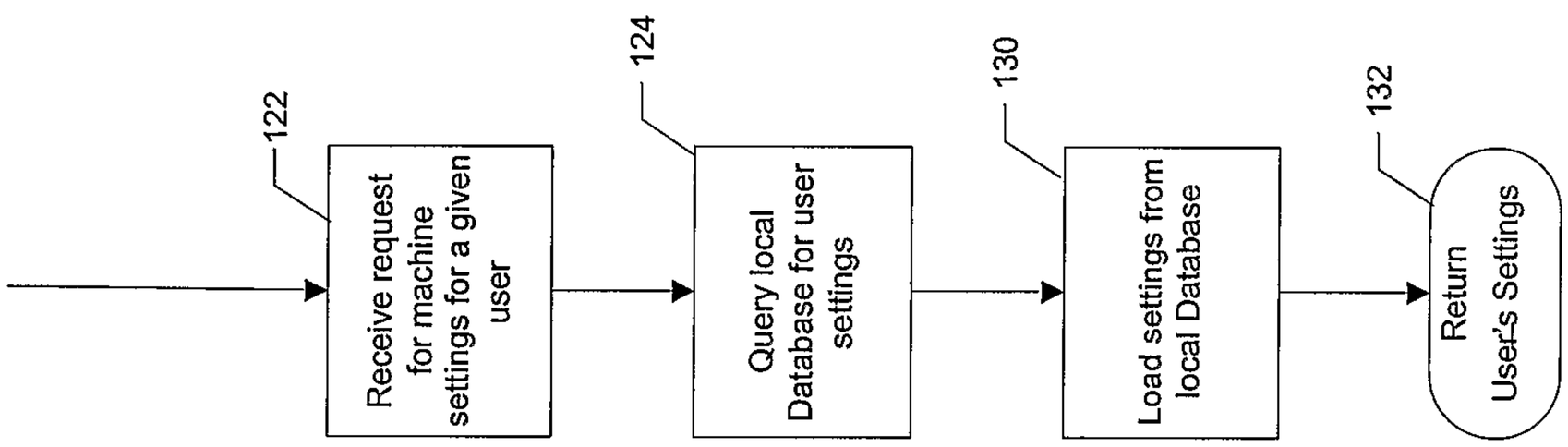
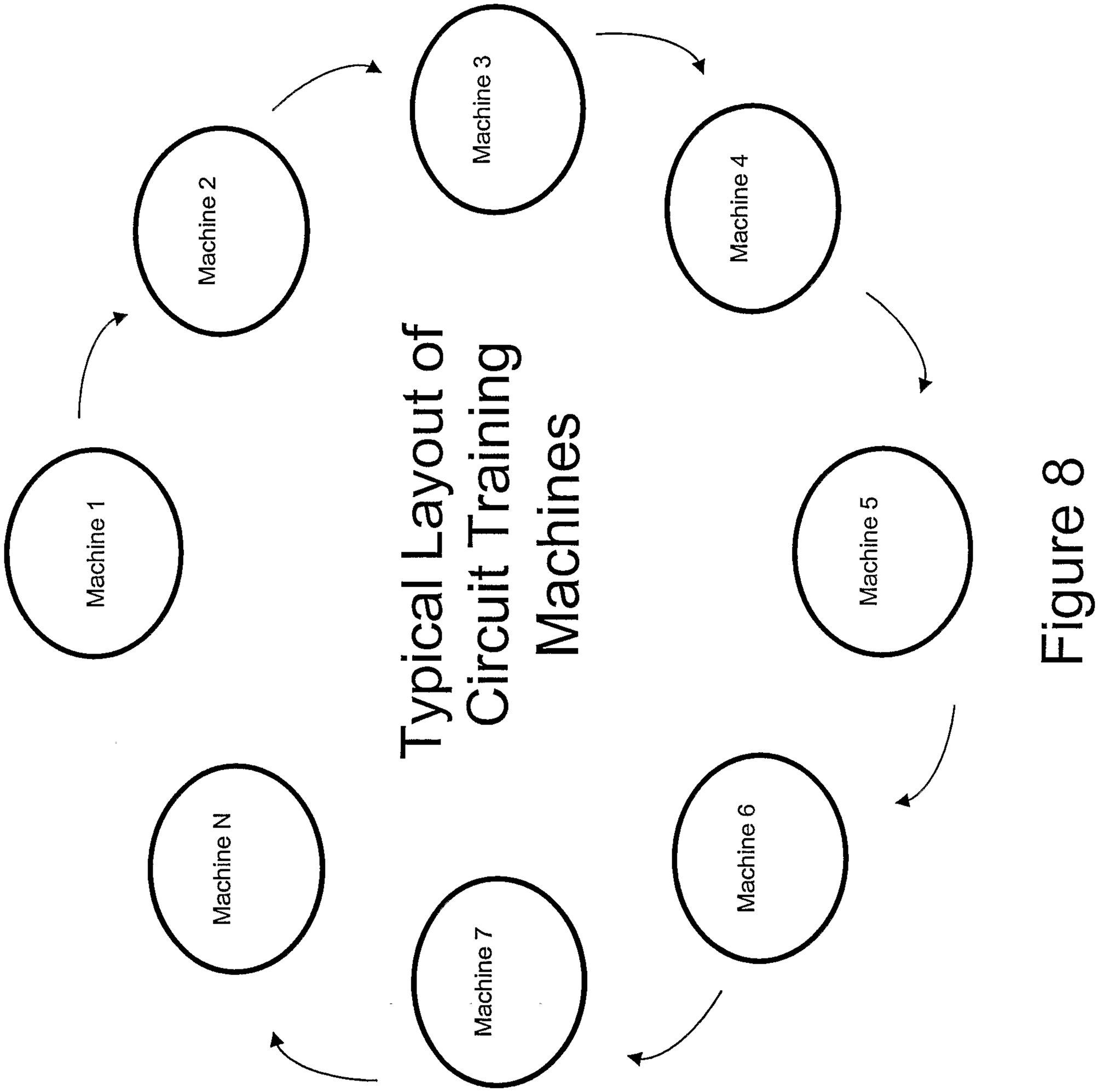


Figure 7

System of retrieving a user's settings



Typical Layout of Circuit Training Machines

Figure 8

System Layout of
A Single Machine

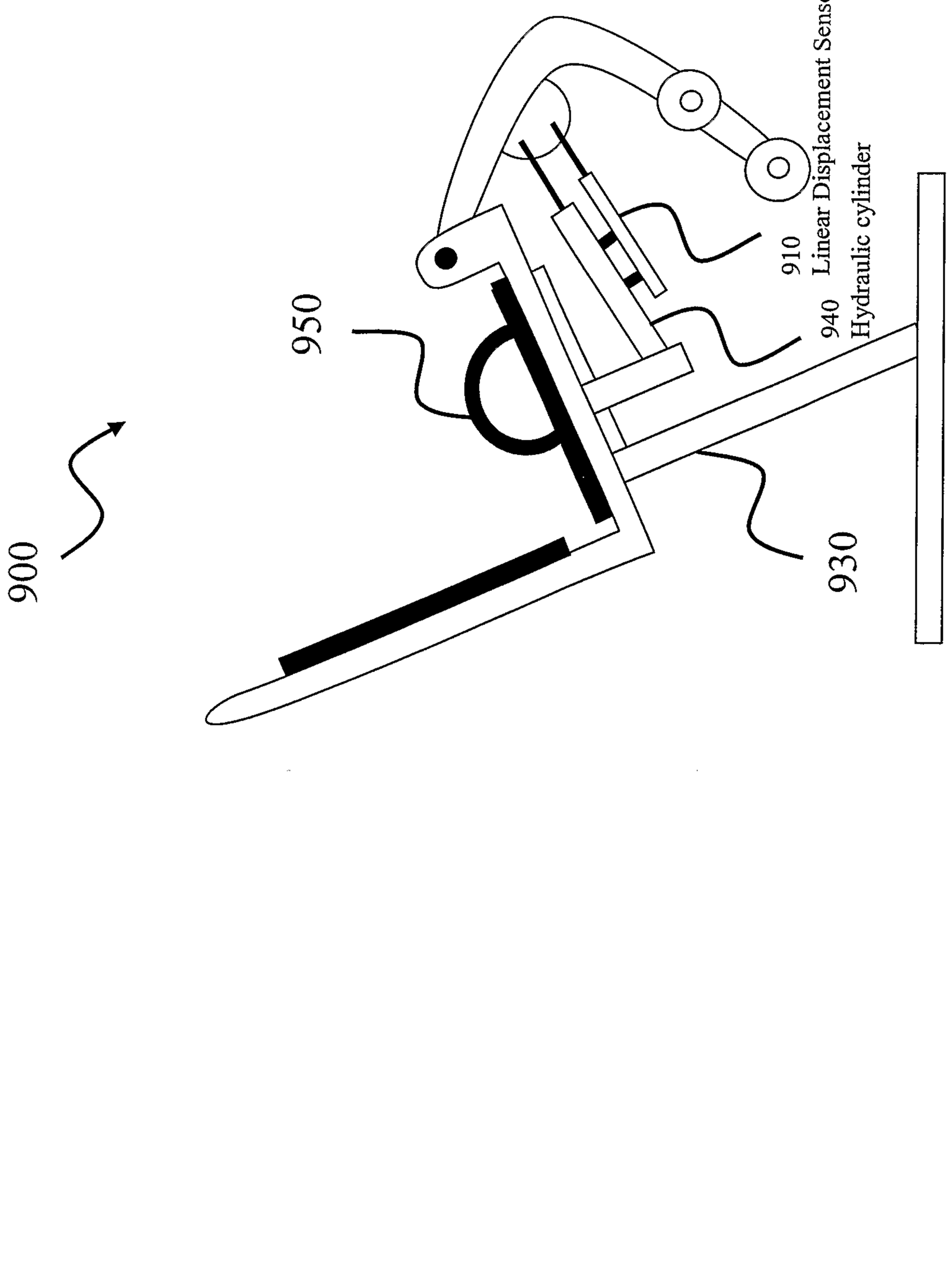
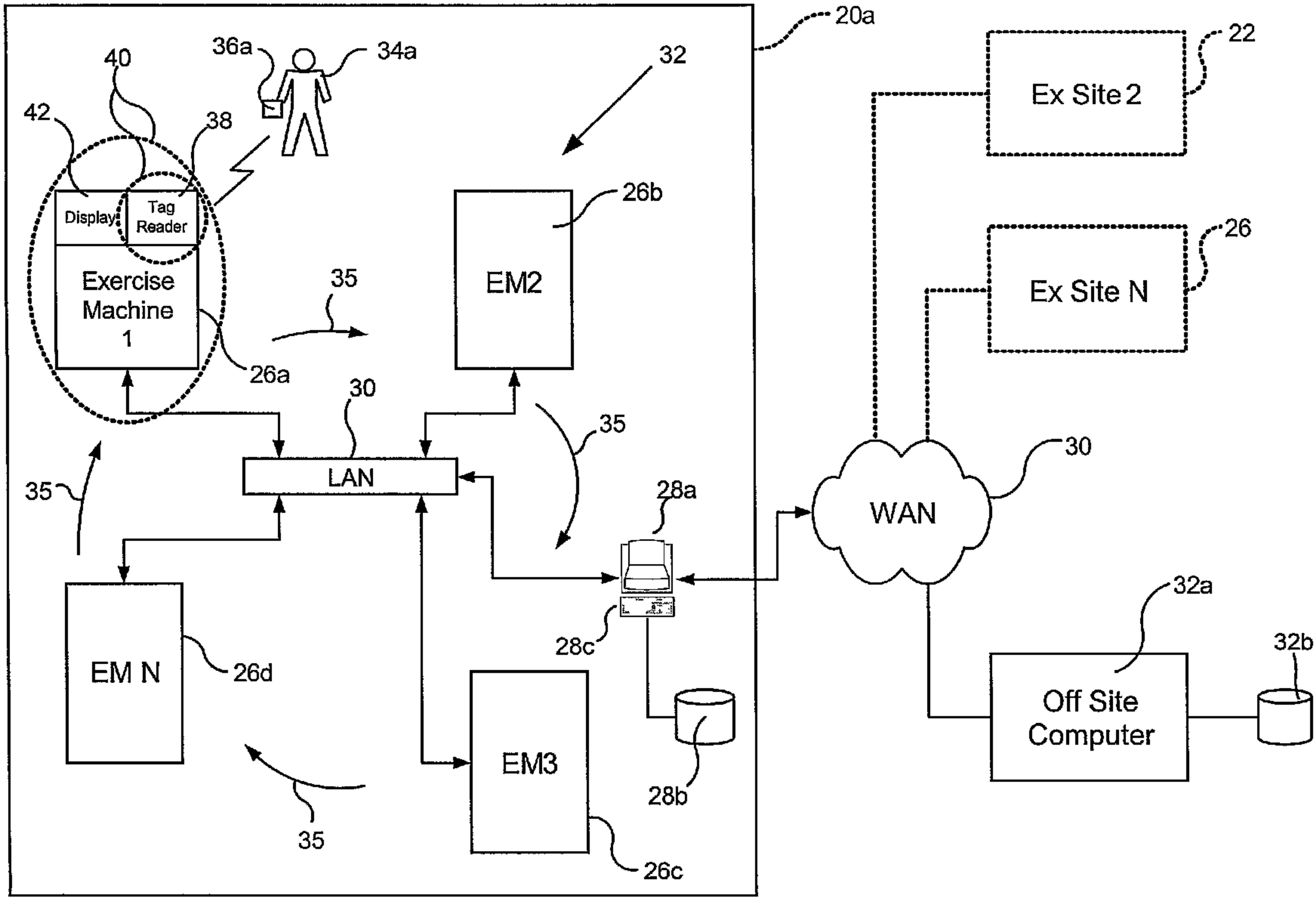


Figure 9


20a
22
Ex Site 2
26
Ex Site N
30
WAN
32a
Off Site Computer
32b
40
36a
34a
32
42
38
Display
Tag Reader
Exercise Machine 1
26a
26b
EM2
35
30
LAN
35
28a
28c
28b
EM N
26d
EM3
26c
35